September 1974
Volume 18
Number 5

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Mariners Weather Log

National Oceanic and Atmospheric Administration • Environmental Data Service

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Mariners Weather Log

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September 1974
Volume 18 **Number 5**
Washington, D.C.

Cover: A gaping hole scars the bow of the $10.5 million Norwegian oil tanker WILSTAR, which was struck by a freak wave in the Indian Ocean off South Africa on May 17, 1974. Damage, estimated at $1.2 million, included steel hull plates almost 1 in thick that were torn like paper. For details on these extraordinary waves see "Important Notice, Freak Waves off South Africa" on page 297. Wide World Photo.

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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget, July 26, 1973.

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MARINERS WEATHER Log

IMPORTANT NOTICE

FREAK WAVES OFF SOUTH AFRICA

Mr. Robert Quayle, of the National Climatic Center, Asheville, N. C., author of the timely article, "Cape Rollers - Unusually High Swells off the South African Coast," which appeared in the May 1974, Vol. 18, No. 3, issue of the Mariners Weather Log, sent the following additional information concerning this phenomenon.

"Because of the considerable interest expressed, I would like to add a few points to the article, "Cape Rollers - Unusually High Swells off the South African Coast," which appeared in the May 1974 issue.

"In addition to the unique synoptic meteorological conditions outlined in the article, the southeast African coast offers an unusual combination of:

(a) A narrow continental shelf with a steep bathymetric gradient in the continental slope area.

(b) A swift current (the Agulhas) running along shore from the northeast toward the southwest.

"The swells, moving unimpeded from the storms to the south, encounter the above conditions in a direction opposite to the current and parallel to the continental slope. The combination can be catastrophic, as evidenced May 17, 1974 by the $1.2 million damage wrought on the Norwegian tanker WILSTAR when her bow was ripped open by a roller off Durban."

SUPERWAVE DAMAGES SHIP OFF SOUTH AFRICA

The latest victim to Cape Rollers occurred south of Durban, near 31.2°N, 30.5°E. The fully loaded 132,700-ton Norwegian oil tanker WILSTAR (cover picture) was sailing southwestward in the Agulhas Current, about 10 mi east of the 100-fathom line, in a southerly gale (fig. 1).

The Captain reported that the waves were coming in sequences of seven on the bow. In one sequence the seventh wave did not hit them; instead there was no sea in front of the bow, only a hole. The bow fell into the hole and then the seventh wave, higher than the bow, crashed onto the ship. The WILSTAR lost her bulbous bow. Heating pipes and decking were damaged. Steel hull plates almost an inch thick were torn away. Beams thicker than railway tracks were snapped. The damage was estimated at $1.2 million.

This area is regarded by mariners as one of the most dangerous in the world. Freak waves have

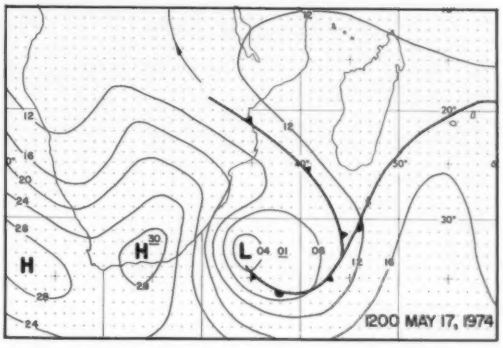

Figure 1.--Synoptic weather chart shows the LOW off the southeast coast of South Africa that wrought the damage to the ill-fated WILSTAR.

claimed many ships and lives. Expert oceanographers are not certain of the specific reasons for the relatively numerous occurrences of the high waves and deep troughs in this area. The Agulhas Current flows from north to south with a speed of about 5 kt. Divers have reported much greater underwater speeds. The continental shelf drops very abruptly in this area. The southward flowing current and the northward blowing southwest winds must certainly be involved, but the freak waves have been reported in relatively calm seas. The sharply dropping continental shelf probably is an influence. Storms far to the south may send swells into the area.

Nautical charts carry warnings that abnormal waves preceded by a deep trough may be encountered in the area between the edge of the continental shelf and 20 mi to seaward. Notice to Mariners Number 42 (3866) 73 was issued by the U. S. Defense Mapping Agency Hydrographic Center. The following Notice to Mariners, dated 30 June 1973, was issued by the Union of South Africa:

South Africa - East Coast

Caution regarding freak waves

1. Investigations into storm damage received by

ships off the east coast of South Africa between East London and Richards Bay in recent years have shown that freak waves of 20 m (66 ft) or more in height preceded by a very deep trough occasionally occur in the area on the seaward edge of the continental shelf.

a. These waves can occur when an area of low pressure moving to the east-northeastward produces a strong southwesterly wind blowing against the flow of the Agulhas Current. This raises waves some 7 to 8 m (23 to 26 ft) high with a frequency of about ten seconds and length of 60 to 90 m (200 to 300 ft) moving to the northeast. There may also be wave trains emanating from storm centers further south. These have a frequency of about 16 sec and are of much greater length but they also move in the same northeasterly direction.

b. When the crests of these two wave trains coincide a freak wave of some 20 m (66 ft) in height preceded by a deep trough is the result. The lifetime of such a wave is short and it will only extend over a distance of about one cable (200 yd).

c. Although the chances of meeting such a wave are slight, several ships have encountered them and have suffered severe damage. Mariners are warned that caution should be exercised when steaming on the seaward edge of the continental shelf against a strong southwesterly wind with a low barometer.

THE 1973-74 GREAT LAKES ICE SEASON

Daron E. Boyce
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Great Lakes mariners were tested to their fullest during the 1973-74 ice season--especially on the northern waters. Below-normal temperatures brought severe ice conditions to Lake Superior, the Straits of Mackinac, and the St. Mary's River by early February, and ended shipping abruptly on February 7, 1974--1 day short of the record established the previous year. The spring 1974 opening also proved to be unusually challenging in the upper Lakes. Ship damage was common and at least three lives were lost in ice-related accidents. Temperatures over the southern waters were above normal for the third straight year and an easy season was the rule there.

FALL FREEZE-UP

Shipping on the Great Lakes was very active through the fall months of 1973. The National Weather Service predicted a late freeze-up and the demand for steel and coal products remained high. Lake Carriers Association figures for October indicated movement of 65.3 million tons of iron ore for the season, the highest since 1960. Grain exports were also at record levels for the season. At Sault Ste Marie, Mich., the Army Corps of Engineers reported their first million-ton weekend in 30 yr on November 10 and 11.

Abnormally cold weather in early November dropped water temperatures in the upper Lakes sufficiently to produce some skim ice at Duluth on November 10. Warmer weather for the remainder of the month delayed any further development. Although the relatively mild temperature trend continued into December, colder air masses began to spread over the Lakes region during the second week and ice cover formed quickly at Duluth, Green Bay, the Straits of Mackinac, the St. Mary's River, and Saginaw Bay by mid-month. The first icebreaking assistance of the season was rendered to the FRED A. MANSKE by the USCGC MESQUITE on her way out of Green Bay on December 16. Three days later the USCGC WOODRUSH broke harbor ice at Duluth.

EXTENDED SEASON OPERATIONS

The fuel shortage and generally favorable fall weather allowed the St. Lawrence Seaway and Welland Canal closings to be extended. Closing dates were extended 4 days to December 20 and January 4, respectively. Adverse weather during the last days of the season slowed navigation considerably and the final downbound passages at Montreal by the Panamanian freighter SEBASTIANO and Canadian tanker ALEX HEIBERG were not logged until December 22. Preliminary reports to the Great Lakes Commission indicated another record year on the Seaway with cargo totaling 57.6 million short tons--about 7 percent over the 1972 record.

Continued ice growth into the third week of December caused difficult navigation near Duluth, in Saginaw Bay, Green Bay, and Lake St. Clair. Five ships were assisted through Saginaw Bay by the Coast Guard Cutters ACACIA and BRAMBLE. A short spell of milder weather around Christmas diminished the ice cover on Lake St. Clair and new ice in the western basins of Lake Erie, and halted further growth in northern waters. Much colder weather by New Year's permitted rapid reformation and growth--especially in the upper Lakes.

The fifth new bulk carrier to be placed in service during 1973 completed her maiden voyage during the difficult second half of December. The $35 million PRESQUE ISLE (fig. 2) left Erie, Pa. on December 16. On December 22, she left Two Harbors, Minn. with a 58,000-gross ton cargo of iron ore pellets for Gary, Ind.

One Great Lakes seaman was lost on December 26 as a result of a winter storm. Twenty year-old John Lessler was lost off the FRONTENAC as she headed northbound on Lake Huron near Stoneport in a freezing rain storm.

Figure 2.--PRESQUE ISLE, the newest lake carrier, a 1,000-ft tug-barge combination, finds little resistance in moving downbound through the Detroit River on the last day of the year. Photo courtesy of A. Ballert, Great Lakes Commission.

The Welland Canal closed for the season on January 4, only the second time in its history that operations continued beyond December. The last passages were made by Canadian vessels SAGUENAY and MANITOULIN.

The abnormally cold weather continued into January and ice increased both in coverage and thickness in the northern sections. By mid-month ice coverage was nearly complete in the St. Mary's River, Green Bay, the Straits of Mackinac, Saginaw Bay, Lake St. Clair, and western Lake Erie (fig. 3).

The first ship casualties of the ice season were recorded in January. On January 8, the BENSON FORD was grounded in western Lake Erie. The HENNEPIN, DETROIT EDISON, and MIDDLETOWN were beset in heavy ice in the same area. The FORD was not freed until January 13. Three days later operations on the coal shuttle between Toledo and Detroit were suspended for the season. Four other ships were damaged during the month. The LEON FALK, JR. sustained damage, on January 8, in the St. Mary's River; ERNEST T. WEIR, on January 12, in Lake Huron; and CONSUMERS POWER, on the 13th, in Lake Erie. The LEON FRASER was forced into early winter lay-up from damage, on the 17th, in the Straits of Mackinac. Three hard-working USCG Cutters also were on the casualty list. The KAW and NAUGATUCK were damaged on January 8 and the OJIBWA on the 18th.

Other hardy vessels and stalwart crews continued to operate through the severe cold and biting winds of January. On New Year's Day U.S. Steel's 1,000-ft ROGER BLOUGH loaded her two millionth ton, while temperatures ranged down to minus 25° F on Lake Superior.

The annual January thaw arrived during the third week almost as if it had been scheduled. The mild spell was most prevalent in the southern Lakes. The mercury soared to 64°F in Cleveland, on the 20th. In northern sections the mercury poked above freezing occasionally and ice conditions stabilized. A maximum temperature of 35°F. on January 26 was the only high mark above freezing during the month at Duluth.

Wintry weather resumed in early February and resulted in rapid reformation of the ice cover on Lake St. Clair, western Lake Erie, and most shorelines. The number of operating vessels decreased to only a handful by early February, and icebreaking assists greatly increased. Twenty-five ships were escorted or assisted on the first day alone. Ice conditions worsened to the "severe" level by the end of the first week. Ships in the Straits of Mackinac reported ice 3 ft thick. At mid-day on February 6 the decision to end the season was made and six Great Lakes Fleet vessels underway headed for winter lay-up. The U. S. Steel ships FAIRLESS, FERBERT, and CLARKE sailed for winter ports on Lake Michigan. The ANDERSON which was headed upbound in the Straits turned around, and the ROGER BLOUGH and the JOHN MUNSON which were already downbound from the head of the Lakes became the last ships to lock through the St. Mary's River,

Figure 3.--Winter on the Great Lakes brings scenes of pristine beauty but the lake carriers face rugged resistance from the ice in attempting to extend the winter season. Photo courtesy of Seaway Review Magazine.

at Sault Ste Marie, during the early hours of February 7, 1974. They completed their run to southern Lake Michigan and laid up on February 9.

Although the closing date of the Soo Locks was 1 day short of the record set in 1973, cargo tonnage as reported by the Great Lakes Commission was up 42 percent for the "extended season" beginning December 17. Lake Carriers Association and U.S. Coast Guard figures indicate a substantial increase in participation in the extended season program by the shipping industry this season. Vessels operating during at least a portion of the "extended season" totaled 122 this season compared to 91 last season and 47 in 1972.

Some navigation continued during the remainder of February in spite of the severe ice. Several ferries fought the ice, at times with the help of the U.S. Coast Guard fleet, and a few tankers hauled much needed petroleum products. Another notable exception to the "suspended season" was the tug and barge combination JAMES A. HANNAH. The tugboat and 290-ft barge braved the wintry weather during most of February. Although she was disabled occasionally and was beset several times in the ice, she established late season port records at Marquette, January 20; Sarnia, February 9; Bay City, February 13; and Mackinac Island, February 20. The last trip was the latest ever recorded through the Straits.

The maximum ice cover for the season (figs. 4 and 5) was observed during the third week in February. Ice over 2 ft thick was reported at some shore

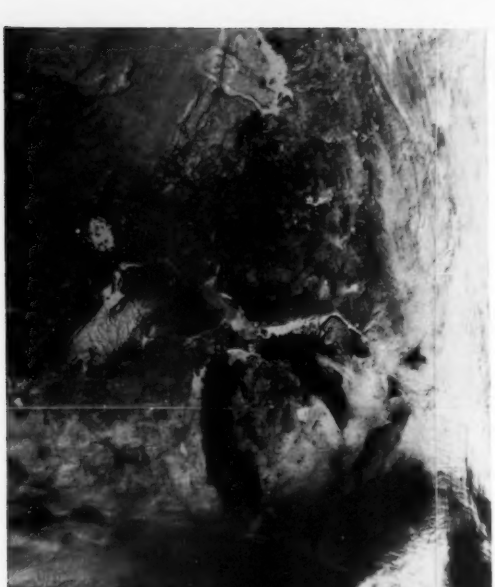

Figure 4.--NOAA-2 Satellite Very High Resolution picture of Great Lakes ice cover on February 20, 1974. Ice cover at this time was near its maximum for the 1973-74 season.

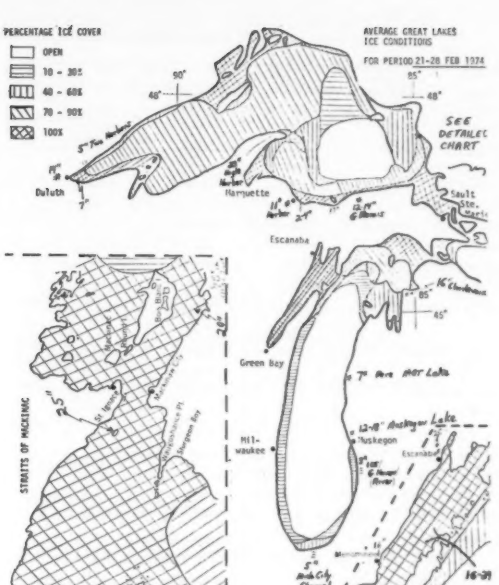

Figure 5.--Composite map of the ice cover on the western Great Lakes for the period February 21-28, 1974. Maps similar to this were transmitted directly to ships by radiofax this season.

sampling locations.

SPRING OPENING

Milder weather spread over the Lakes region during the last few days of February and continued through the first week of March. Spring storms bringing frequent rainfall and southwest winds resulted in substantial melting. The southwest gales also created problems as drift ice was jammed into the eastern end of Lake Erie. Some loss of ice cover occurred over the northern waters.

Late winter's fickleness persisted into the remainder of March with alternating weeks of cold and mild weather. Lake St. Clair was ice free and Lake Erie's ice was concentrated in the vicinity of Buffalo by the end of the second week of March. During the third week colder weather combined with high winds to produce much pressure ice in the Buffalo area. New ice formed over Lake Superior and the Straits of Mackinac.

Encouraged by the mild weather periods and the demands of the energy crisis and the steel industry, some ships ventured out during the latter days of March. The S. T. CRAPO lost her rudder in the ice, on a voyage through the Straits of Mackinac, on March 28. Two commerical tugs were dispatched to her aid from Sturgeon Bay. One of them, the 98-ft LAUREN CASTLE, was towing the CRAPO when tragedy struck on March 30. The tow line broke and a wave smashed across the stern of the LAUREN CASTLE. Two crew members, Ronald Smith, son of the CASTLE's captain, and Mel Selvic, son of the owner of the other tug, JOHN H. SELVIC, were thrown into the lake and lost.

The planned opening date of April 1, on the St. Lawrence Seaway, was pushed up to the record early date of March 26. Severe storms and a Canadian seamen's strike hampered operations in April and it was not until the 26th that the CANADIAN HUNTER entered the Seaway at Iroquois. A Yugoslav ship preceded the HUNTER westbound and cleared St. Lambert Lock on March 30. The Canadian freighter MEAFORD opened the Welland Canal season on March 29.

Canadian ships held the spotlight in the upper Lakes also. The USCG Icebreaker SOUTHWIND escorted four grain-laden freighters into Lake Michigan, on March 26, to open the Straits of Mackinac. Severe ice conditions in the St. Mary's River and Lake Superior discouraged U.S. vessels until later in April, but the Icebreaker MACKINAW escorted eight Canadians headed by the R. BRUCE ANGUS, on April 1, through the Poe Lock at Sault Ste Marie. They all sailed for Thunder Bay (table 1). Three of them, JAMES NORRIS, GORDON LEITCH and WHEAT KING, sustained ice damage during early April.

Southwestern Lake Superior, Whitefish Bay, the Straits of Mackinac, and Green Bay remained nearly ice covered and very difficult for navigation during the early part of April. Northeasterly winds created a great amount of pressure at Duluth until mid-month.

Table 1.--Verification of Opening of Navigation Outlook 1974

Location	Predicted 1974 Opening - Icebreaker	Predicted 1974 Opening - Natural	Actual Opening	Ship
Duluth	April 2	April 10	April 9	CLARK
Marquette	April 7	April 14	April 7	DYKSTRA
Whitefish Bay	April 2	April 15	April 2	ANGUS
St. Mary's River	April 1	April 14	April 2	ANGUS
Straits of Mackinac	March 28	April 12	March 26	SHERMAN
Green Bay/Escanaba	March 30	April 14	March 21	J. BOLAND
Alpena	- - - -	March 21	March 16	J. B. FORD
Southern Lake Huron	- - - -	March 30	March 16	J. B. FORD
Saginaw Bay	March 26	April 2	March 26	CORNELIUS
Western Lake Erie	- - - -	March 18	March 6	J. B. FORD
Buffalo	April 5	April 12	March 24	CONSUMERS POWER
		Other Port Openings		
Toledo			March 4	CGC KAW
Ashtabula			March 13	BENSON FORD
Lorain			March 12	TUG DONNEGAL
Cleveland			March 20	HENNEPIN

Abundant sunshine and milder weather decayed the ice in the Straits and only drift ice remained west of the bridge. By the end of the third week, much open water existed in Whitefish Bay and the St. Mary's River, and vessels were transiting unassisted.

The areas of greatest difficulty through the remainder of April were the southwest corner of Lake Superior and the bays behind Isle Royale. Duluth was ice-free by April 26, but some drift ice was left in the open lake until about May 1.

Table 2.--Great Lakes Departures from Normal* of Air Temperature (°F) for 1973-74 Season

Month	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
November	+0.5	+1.2	+1.8	+2.7	+2.9
December	-1.7	-1.1	-0.8	+1.4	+2.5
January	-2.4	0.0	+0.7	+2.0	+1.9
February	-3.1	-2.0	-3.0	-2.2	-3.5
March	-0.9	+1.4	+1.7	+2.3	+0.7
April	+0.5	+1.6	+2.6	+2.0	+4.3
November-April	-1.2	+0.2	+0.4	+1.5	+1.6

*Using 1931-60 Normals.

SUMMARY

Temperatures across all of the Lakes region were well above normal through the summer and fall of 1973, but two contrasting weather regimes ruled during the winter and spring months. Temperatures around Lake Superior were below normal and around the lower Lakes (Erie and Ontario) readings averaged above normal for the period. Near normal temperatures were reported over Lake Huron and most of the Lake Michigan area. See figure 6 and table 2. As might be expected, the ice coverage over Lake Superior was greater and in general thicker than normal, the heaviest for several years. The southern lakes continued their below-normal ice coverage of the past seasons.

Icebreaking figures supplied by the Ninth Coast Guard District indicate a marked increase in the number of assists from last season, but about the same

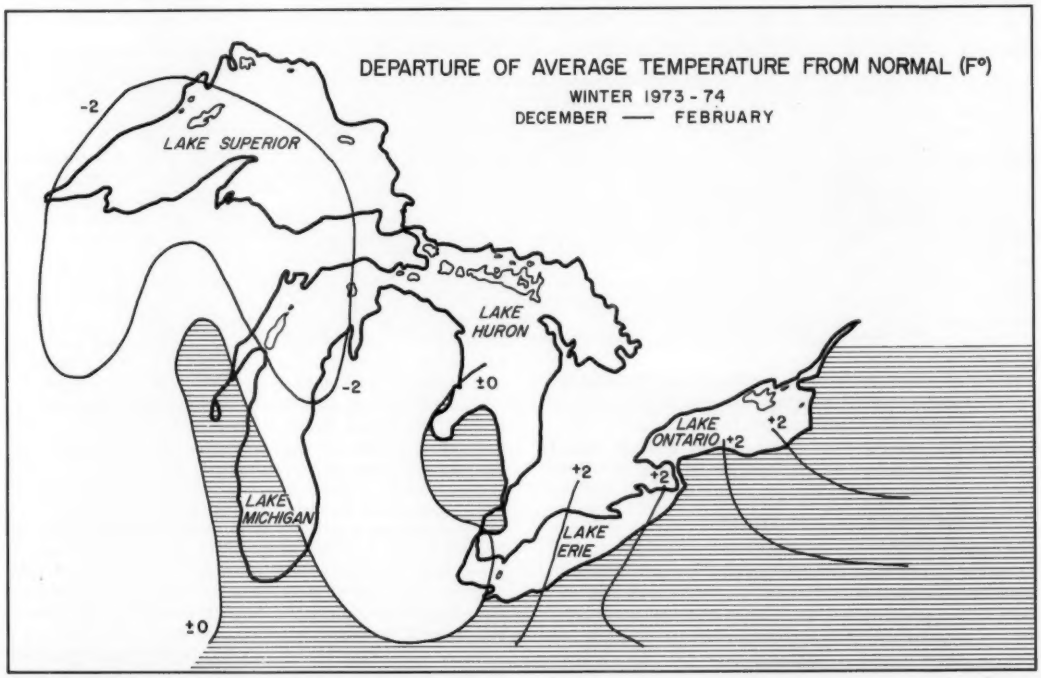

Figure 6.--Temperatures during the winter months December through February averaged below normal over Lake Superior and portions of Lake Michigan; above normal over Lake Erie and Lake Ontario and about normal elsewhere.

Table 3.--Maximum Accumulated Freezing Degree Days (FDD)

Station	Maximum Accumulated FDD--1973-74	Date	Normal Maximum Accumulated FDD	Date	1973-74 Season Versus Normal
Duluth	2528	April 8	2281	April 3	+247 (Colder)
Marquette	1348	April 8	1361	March 30	- 13 (Warmer)
Sault Ste Marie	1893	April 9	1702	April 3	+191 (Colder)
Green Bay	1286	March 29	1416	March 26	-130 (Warmer)
Milwaukee	811	February 26	880	March 15	- 69 (Warmer)
Muskegon	703	February 26	593	March 16	+110 (Colder)
Alpena	1239	March 30	1164	March 28	+ 75 (Colder)
Detroit	557	February 26	*(347 in 72-73)	(Feb. 28 in 1973)	
Toledo	613	February 26	500	March 2	+113 (Colder)
Cleveland	163	January 13	343	February 28	-180 (Warmer)
Buffalo	530	February 27	489	March 18	+ 41 (Colder)
Rochester	514	February 26	586	March 18	- 72 (Warmer)

*Information not available.

number of hours spent in service to shipping for icebreaking. During the 1973-74 season, 430 assists or escorts were made by 13 Coast Guard Cutters and Icebreakers on the Great Lakes. The hours of icebreaking service totaled 5,044 this season as compared to 5,611 last season.

Another indicator of the severity of the season is the total of freezing degree-days recorded at selected National Weather Service Offices. A freezing degree-day figure is obtained for each site by subtracting the mean temperature for the day from 32°F. Cumulative totals are compiled with negative daily figures (melting degree-days) included. The maximum accumulated freezing degree-days occurred in late February at most stations. Lake Superior stations were an exception with all maximum accumulated freezing degree-days occurring in early April. The greatest ice cover is closely correlated with the maximum degree-days (table 3).

ACKNOWLEDGEMENTS

Much of the statistical and background data for this report was extracted from the 1973-74 Final Operations Report, by the National Weather Service contractor, Bernard DeWill and Associates, Ann Arbor, Mich. Icebreaking and casualty information was provided by Lt. Tom Brennan, Chief Icebreaking Section, Ninth Coast Guard District, Cleveland, Ohio.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

OBJECTIVE ANALYSIS OF SEA-SURFACE TEMPERATURES USING MARINE OBSERVATIONS

Brian Jarvinen
National Hurricane Center, NOAA
Miami, Fla.

Editor's Note: Mariners may often wonder why the various parameters are required to be measured for the "Ships Weather Observation" report. Of what use is the sea temperature for instance? Why the accuracy to tenths of a degree? This article concerning sea-surface temperature and its possible effect on tropical cyclone activity is an example of why the requirement, and the results indicate the need for extreme accuracy, as only fractions of a degree appear to be determining factors. Accurate marine weather observations are needed from all parts of the world and for all meteorological conditions. These observations are used for many varied purposes from basic research to operational forecasts.

For years hurricane forecasters have realized the importance of the field of sea-surface temperature and its possible effects on tropical cyclone activity. Several investigators have demonstrated the feasibility of producing sea-surface temperature charts in real time over a limited domain by manual methods, but routine production of such charts over a broad area has had to await the development of computerized procedures. Although a description of the sea-surface temperature field is valuable in assessing the probability of tropical cyclone formation or intensification, the time required to manually average, plot and analyze sea-surface temperature values for 3-, 7-, 15-, or 30-day periods is time the forecaster can ill-afford when a storm is in progress.

Therefore, during the hurricane season of 1972 a program was developed to objectively analyze the sea-surface temperatures using marine observations collected for a particular time period. This program was run operationally for the first time during the 1973 hurricane season and some of the results will be presented here.

The objective analysis method is of the circular scan type and is essentially the one devised by Cressman (1959). It involves making corrections to initial values at grid points using actual data within some given radial distance of each point. These corrections are weighted according to the distance of the actual data from the grid point. The grid points are corrected four or five times using data within successively smaller circular areas.

The initial or first guess field consists of sea-surface mean temperatures. Means were computed by using all of the observations within one degree quadrangles for each month during the years 1941 through 1971. The Scripps Institution of Oceanography provided means based on observations by cooperating merchant vessels, the U.S. Navy, Coast Guard, National Ocean Survey, National Marine Fisheries Service, Duke University, Texas A&M University, University of Miami, Woods Hole Oceanographic Institute, and a few British research and naval ships.

Because of the warming and cooling that occurs over a period of months it was necessary to interpolate the monthly mean sea-surface temperatures to the center day of that particular time period. For example, if the time period is July 1 through 7 then the June and July monthly means are used and an interpolation is made for July 4. This interpolated monthly mean serves three important purposes:

1. It is an ideal first guess field.
2. It can be used to check isolated station reports by allowing only acceptable deviations of the sea-surface temperature values.
3. It can be used to compute anomalies.

Although the bulk of the information is from ship observations, sea-surface temperature observations from oil rigs, buoys, and other sources can be added at execution of the program.

Erroneous observations are handled by using a "buddy" data check system obtained from the National Meteorological Center and modified to apply to sea-surface temperatures. As mentioned above, isolated observations are checked against the monthly mean. Areas devoid of observations will have the monthly mean as the final analysis.

The analysis is carried out over an area from 5°W to 123.5°W and from the Equator to 45°N. The grid is 35 by 80 and the distance between grid points is 167 km.

Figure 7 is an example of a sea-surface temperature analysis in °C for a recent 7-day period, (June 22-28, 1974). The more prominent features are:

1. The area of greater than 27°C in the Eastern Pacific Ocean with the strong sea-surface temperature gradients to the north and south
2. The warm Gulf of Mexico and Caribbean regions
3. The warm tongue of water along the southeastern United States coast indicating the Gulf Stream
4. The very strong sea-surface temperature gradient to the north of the Gulf Stream (This gradient is so strong that only the 5°C lines were analyzed.)
5. The cool tongue of water beginning near the

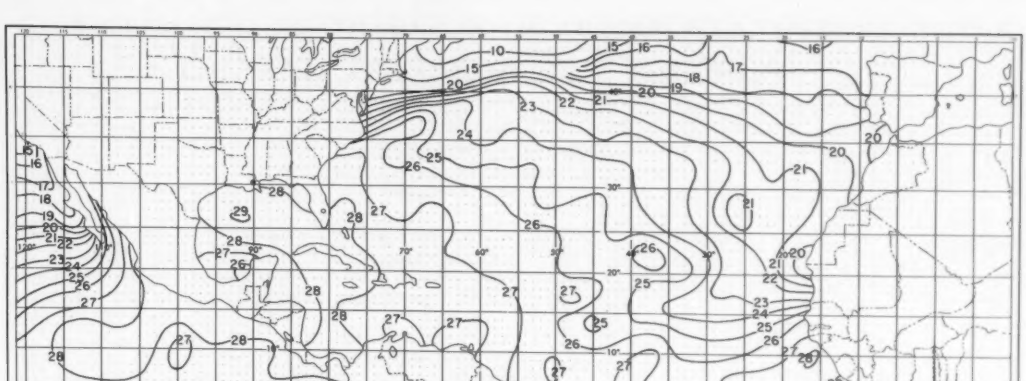

Figure 7.--Sea-surface temperatures (°C), June 22-28, 1974.

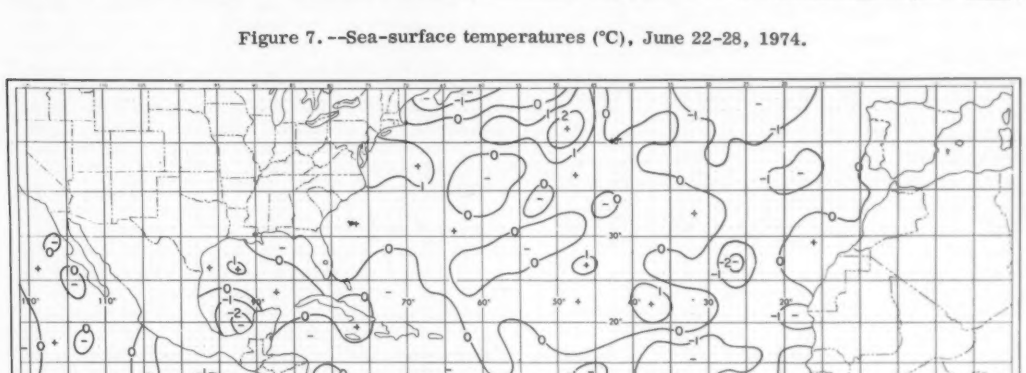

Figure 8.--Sea-surface temperature anomalies (°C) for figure 7.

African coast and extending into the Atlantic Ocean to about 50°W.

Figure 8 represents the sea-surface temperature anomalies in °C for figure 7. The mean used for the anomaly computation was obtained by interpolating the June and July monthly means for June 25. Several features of interest follow:

1. There are large areas of above normal sea-surface temperatures in the Eastern Pacific.
2. There is an area of 1° to 2°C below normal for the Bay of Campeche. This is a significant observation because for 9 days prior to June 22 this area was covered by cumulus and cirrus clouds. Then from June 22 through 25 a tropical depression was in this area. Also for the remainder of this period (June 26-28) cumulus and cirrus clouds persisted. One would certainly expect cooling to occur in a region if the flux of solar radiation was decreased for 9 days and a tropical depression with its flux of latent and sensible heat from the sea surface remained for 4 days.
3. Large anomaly differences can occur with small meanders of the Gulf Stream because of the strong sea-surface temperature gradients.
4. Several large regions of less than one degree centigrade exist between 10°N and 20°N near the African coast.

These weekly sea-surface temperature and anomaly charts are two of several aids to the hurricane forecaster in assessing regions that are favorable for tropical cyclone formation and intensification for the coming week.

For a more climatological overview of what has transpired, sea-surface temperatures and anomalies are computed for a 30- to 32-day period. Figure 9 shows the sea-surface temperature anomalies in °C for the 32-day period Aug. 15 to Sept. 15, 1972. Two distinct features are evident. One, the eastern Pacific is almost totally warmer than normal except for three negative regions. During this time period four hurricanes and one tropical storm formed. Two, the

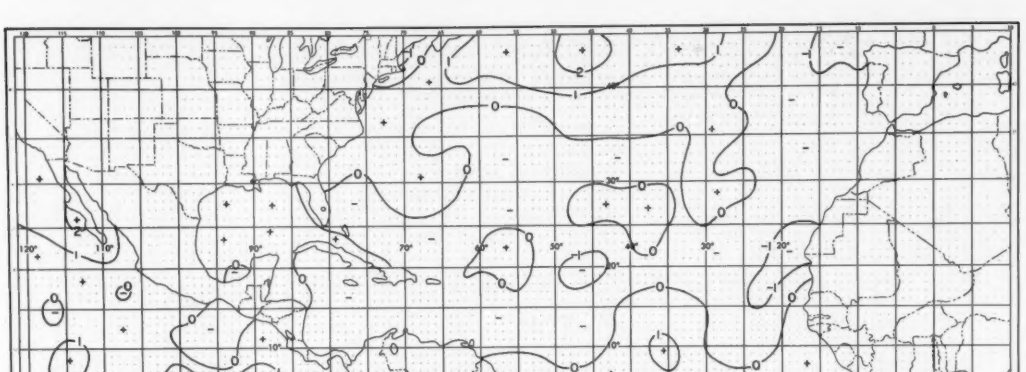

Figure 9.--Sea-surface temperature anomalies (°C), Aug. 15 - Sept. 15, 1972.

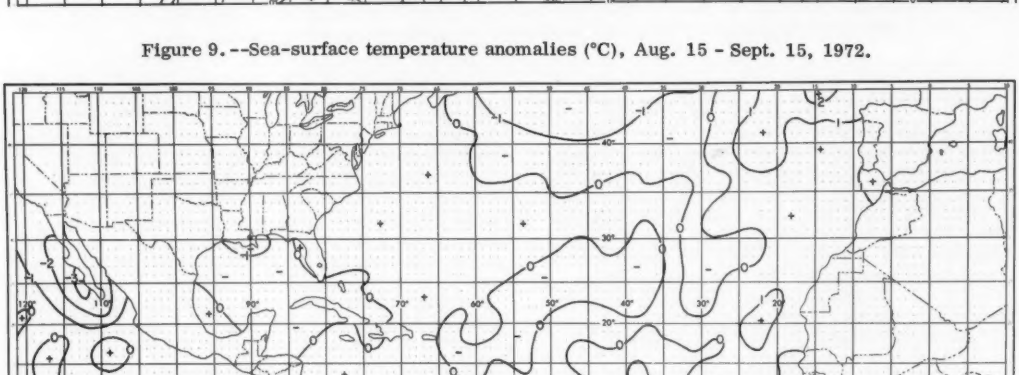

Figure 10.--Sea-surface temperature differences (°C), Aug. 15 - Sept. 15, 1973 minus Aug. 15 - Sept. 15, 1972.

region in the Atlantic from 10°N to 25°N and from the African Coast to 80°W was mostly cooler than normal. During this time no tropical cyclone formation took place. In fact, this condition in the Atlantic persisted from June through September 1972 with no tropical cyclone formation.

To see if this trend continued into 1973, figure 10 was produced. This figure represents the Aug. 15 to Sept. 15, 1973 sea-surface temperatures. The Eastern Pacific area was almost totally cooler in 1973 than in 1972 for this time period. Only one weak tropical storm (Heather) formed during this period. The Atlantic on the other hand shows very irregular patterns of both warmer and cooler regions. The warmed up area near the African Coast may be significant in that the first Cape Verde-type storm in 6 yr occurred. The subjective use of the charts as indicated above has helped pave the way for their future use.

The sea-surface temperatures will also be used in the operational primitive equation hurricane models, presently being developed, to help determine the fluxes of energy in the lowest level of the storm. Thus, a more quantitative and objective use of the sea-surface temperatures will be made.

In conclusion, it should be emphasized that surface ship reports, with their many pieces of information, are being used extensively not only by the hurricane forecaster on an operational basis, but also by many research groups.

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Simpson, R.H., "The Decision Process in Hurricane Forecasting," NOAA Technical Memorandum, NWS SR-53, 1971, 35 pp.

Taylor, J. G., "An Approach to the Analysis of Sea-Surface Temperature Data for the Utilization in Hurricane Forecasting in the Gulf of Mexico," Progress Report, Office of Naval Research Contract No. 2119(04), A&M Project 286-C.3, Texas A&M University, 1966, 92 pp.

A CLIMATIC COMPARISON OF OCEAN WEATHER STATIONS AND TRANSIENT SHIP RECORDS

Robert G. Quayle
National Climatic Center, NOAA
Asheville, N.C.

For many years it has been suspected that climatological studies derived from transient ship observations may be biased toward good weather conditions. The reason for this is quite simple: Ship's masters tend to avoid foul weather.

Weather routing, which is usually considered to be the culprit responsible for the "nonrandomizing" of ships weather records, has been with us in some form or another for centuries. Masters have always kept a "weather eye" out for "the signs". In addition, radio weather warnings and sophisticated ship routing systems should, if they are operating properly, significantly decrease the encounters of ships with bad storms. A further factor which may bias climatologies developed from transient ships records is the practice of many meteorological services to process only those data from ships well-equipped with meteorological instruments. It is possible these ships also would maintain better communication systems and thus receive storm warnings on a more timely basis than less well-equipped ships.

The purpose of this report is to investigate the possible effects of this fair weather bias on certain widely used climatological summaries.

Since the Ocean Weather Stations remain nearly stationary most of the time and encounter very little fair weather biasing, it was felt the most direct assessment of the phenomenon could be made by comparing a long series of Ocean Weather Station observations with transient ship records.

For each Ocean Weather Station (OWS) studied, two open ocean areas were selected for comparison (fig.11):

1. An area surrounding the Ocean Weather Station
2. An area near the Ocean Weather Station

The "surrounding" areas generally gave better observational coverage because of the incidence of Ocean Station Vessels (OSV's) steaming on and off station. It was not always possible to determine which data were from the off-station OSV's, so all data were used.

Because of the way the OSV's were scheduled, the weather encountered at the time of changeover should not show any regular pattern, but should be relatively random, much like merchant marine observations. The areas "near" the Ocean Weather Stations were selected in a manner which virtually eliminated the off-station OSV data from the sample while retaining a maximum degree of climatic compatibility. Figure 11 shows the areas used in this study. The period of record is generally about 1950-1970.

It may be argued that the proximity of the study areas to the Ocean Weather Stations would afford them very good weather warning service and would thus render them more vulnerable to a fair weather bias. If this is so, then the results presented here should show about the worst cases of fair weather bias in extratropical latitudes.

Several possible methods of analysis were attempted

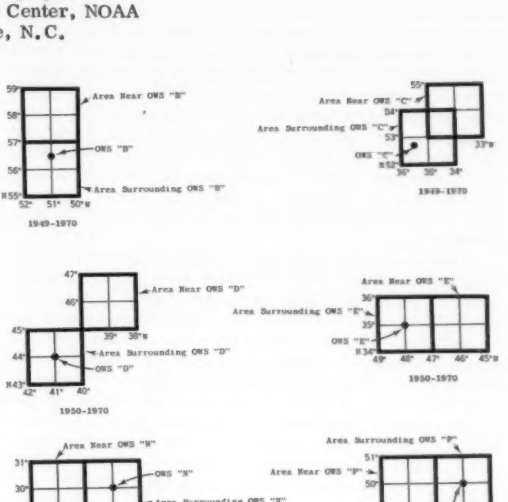

Figure 11.--Areas and periods used in comparisons of transient ship data with Ocean Weather Station data.

before the main presentations in this report were selected. One technique considered was tracking ships to see how often they changed course to avoid storms. The results were a little surprising, since some ships were observed to track directly through storm centers. Because this method was very time consuming and difficult to quantify, it was not pursued beyond a few trial cases. Further, it did not directly answer the basic question of how fair weather bias affects marine data summaries.

One approach which at first seemed promising was the comparison of OWS data with transient ship data via statistical tests of homogeneity. Thermodynamic properties (temperature, pressure) were checked via Fisher's F and Student's t tests. Winds and waves were compared by using these same tests with the addition of Hotelling's T^2 and the Fisher Z transform. Clouds and visibilities were tested using the Kolmogorov-Smirnov test. All results were tabulated on a monthly and annual basis, with tests being performed for all possible area combinations, i.e., OWS vs. near area, OWS vs. surrounding area, and near area vs. sur-

rounding area. Unfortunately, many combinations tested to be nonhomogeneous, not because the differences were of operational significance, but because they were of statistical significance. In other words, the tests were too sensitive for the quality of data being processed. For example, a near-OWS area was compared with a surrounding OWS area. Differences of only a few tenths of a percent in visibility frequencies below 2 mi and a few tenths of a knot in mean wind speed were flagged as highly significant by the tests. While probably physical realities caused by natural gradients, these differences are nonetheless operationally insignificant for most applied problems. It is not our intention to minimize the value of this type of testing, which has been used many times in the past with a high degree of success. Rather, we simply wish to state that such a method did not appear fruitful in this investigation.

A very simple and direct approach was finally chosen. Summaries of a standard type were prepared for every OWS and test area separately. For each specific climatic criterion, percentage departures of the test areas from the OWS value were plotted for both near OWS and surrounding OWS areas on a monthly and annual basis. The actual OWS values for each criterion were plotted as a numeric figure at the bottom of the graph. A solid line connects the plotted monthly values for the test areas surrounding the OWS's while a dashed line is used for the areas near the OWS's. Annual means and total observation counts are plotted on the right side of each graph.

All graphs were analytically inspected. Because of the volume of graphs, a summary of all OWS's was compiled for each element and a single graph prepared.

As an example of how to read the graphs, consider the January data in figure 12a. The average of the 5th percentiles of the wave height distributions for all OWS's combined was 3.7 ft. (five percent of the observations were 3.7 ft or less.) For the test areas surrounding the OWS's the 5th percentile was 2.8 ft, which would need to be adjusted upward by about 32% to equal the OWS value. Thus, the plotted departure is +32%. Likewise, the 5th percentile for areas near the OWS's is 3.0 ft, so the plotted value is +23%.

The formula used is: Percentage Departure = [(Value at the OWS ÷ Value at the test area) −1] x 100

The results of this investigation are discussed by element.

WAVES

As suspected, wave heights reported by the OWS's are almost uniformly higher than those from ships of opportunity. Differences range from about a foot at the 5th percentile to about 2 ft at the 95th percentile (see fig. 12). Similarly, the percentage frequency of occurrence of wave heights ≥5, ≥8, and ≥12 ft is substantially higher for the OWS's (fig. 13).

The explanation for this may go deeper than simple fair weather bias. Since the vessels that patrol the ocean stations are much smaller than most merchant ships, the waves may look higher to the observer at the OWS. This sort of bias is very hard to quantify and is probably not particularly important.

WINDS

It is somewhat surprising that the winds do not show the same bias as the waves. Only the median is

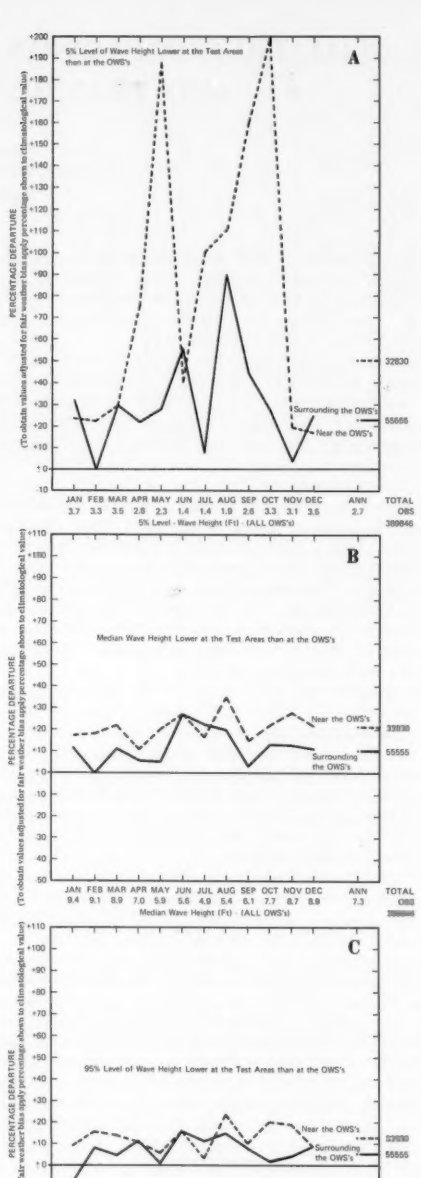
A
5% Level of Wave Height Lower at the Test Areas than at the OWS's
PERCENTAGE DEPARTURE
Surrounding the OWS's
Near the OWS's
32830
55555
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
3.7 3.3 3.5 2.8 2.3 1.4 1.4 1.9 2.6 3.3 3.1 3.5 2.7 OBS
5% Level - Wave Height (Ft) - (ALL OWS's)
B
Median Wave Height Lower at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
9.4 9.1 8.9 7.0 5.9 5.5 4.9 5.4 6.1 7.7 8.7 8.9 7.3
Median Wave Height (Ft) - (ALL OWS's)
C
95% Level of Wave Height Lower at the Test Areas than at the OWS's
95% Level of Wave Height Higher at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
55555
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
20.9 20.4 19.2 15.9 13.4 11.2 10.1 11.0 14.3 16.9 17.8 19.7 16.9 OBS
95% Level - Wave Height (Ft) - (ALL OWS's)

Figure 12a, b, and c. --Wave height; 5th, median (50th) and 95th percentiles. (Chosen as higher of sea or swell when both reports.)

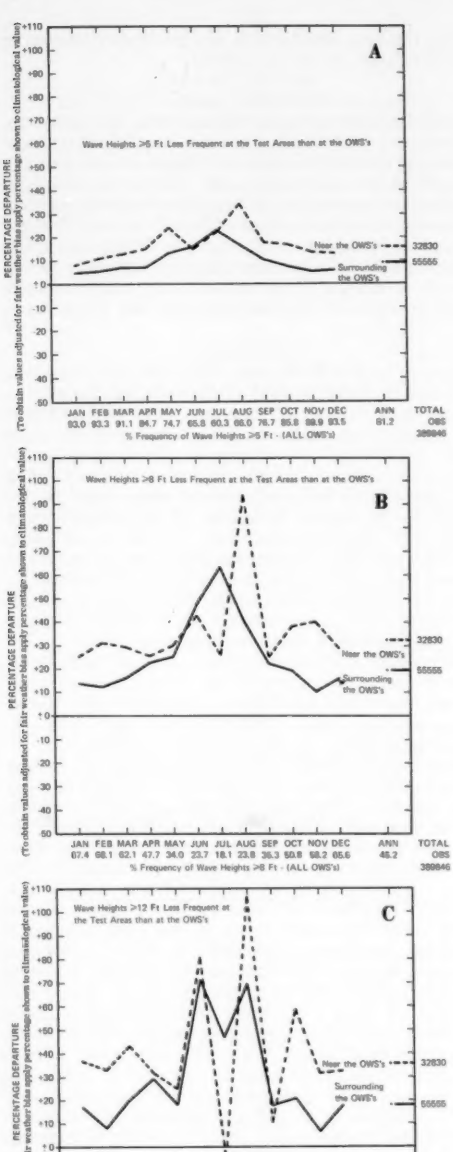
A
Wave Heights ≥5 Ft Less Frequent at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
32830
55555
PERCENTAGE DEPARTURE
(To obtain values adjusted for fair weather bias apply percentage shown to climatological value)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
93.0 93.3 91.1 84.7 74.7 65.8 60.3 66.0 76.7 85.8 89.9 93.5 81.2 OBS
% Frequency of Wave Heights ≥5 Ft - (ALL OWS's) 389846
B
Wave Heights ≥8 Ft Less Frequent at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
32830
55555
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
67.4 68.1 62.1 47.7 34.0 23.7 18.1 23.8 36.3 50.8 58.2 65.6 46.2 OBS
% Frequency of Wave Heights ≥8 Ft - (ALL OWS's) 389846
C
Wave Heights ≥12 Ft Less Frequent at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
32830
55555
Wave Heights ≥12 Ft More Frequent at the Test Areas than at the OWS's
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
38.2 37.4 32.9 20.9 13.2 8.5 4.1 6.6 14.1 24.2 28.6 35.2 21.8 OBS
% Frequency of Wave Heights ≥12 Ft - (ALL OWS's) 389846

Figure 13a, b, and c.--Percentage frequency of wave heights ≥ 5, ≥ 8, and ≥ 12 feet. (Chosen as higher of sea or swell when both reported.)

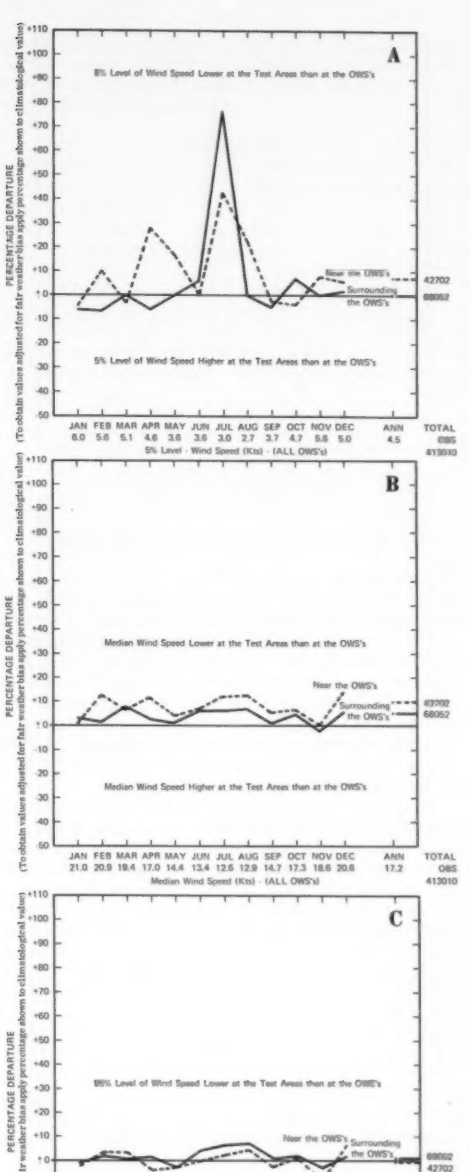
A
5% Level of Wind Speed Lower at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
42702
68052
5% Level of Wind Speed Higher at the Test Areas than at the OWS's
PERCENTAGE DEPARTURE
(To obtain values adjusted for fair weather bias apply percentage shown to climatological value)
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
8.0 5.6 5.1 4.6 3.6 3.0 2.7 3.7 4.7 5.8 5.0 4.5 OBS
5% Level - Wind Speed (Kts) - (ALL OWS's) 413010
B
Median Wind Speed Lower at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
42702
68052
Median Wind Speed Higher at the Test Areas than at the OWS's
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
21.0 20.9 19.4 17.0 14.4 13.4 12.6 12.9 14.7 17.3 18.6 20.6 17.2 OBS
Median Wind Speed (Kts) - (ALL OWS's) 413010
C
95% Level of Wind Speed Lower at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
68052
42702
95% Level of Wind Speed Higher at the Test Areas than at the OWS's
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
39.3 39.0 37.1 32.6 29.1 26.6 24.3 25.6 29.3 33.7 35.7 38.3 32.5 OBS
95% Level - Wind Speed (Kts) - (ALL OWS's) 413010

Figure 14a, b, and c.--Wind speed; 5th, median (50th) and 95th percentiles.

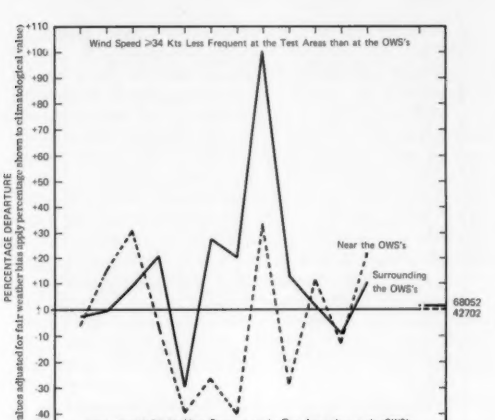
Wind Speed ≥34 Kts Less Frequent at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
Wind Speed ≥34 Kts More Frequent at the Test Areas than at the OWS's
PERCENTAGE DEPARTURE
(To obtain values adjusted for fair weather bias apply percentage shown to climatological value)
+110 +100 +90 +80 +70 +60 +50 +40 +30 +20 +10 ±0 -10 -20 -30 -40 -50
68052
42702
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
14.0 13.2 11.1 5.8 2.9 1.4 0.6 1.2 3.5 7.8 9.7 13.1 7.0 OBS
% Frequency of Wind Speed ≥34 Kts - (ALL OWS's) 413010

Figure 15.--Percentage frequency of gales.

slightly higher at the OWS's, with the 5th and 95th percentiles and gale frequencies showing little difference between test areas and OWS's (figs. 14 and 15).

If we assume that a fair weather bias is operating, then the results for the 95th percentile and gale frequencies are consistent with the contention that estimated winds (which predominate on transient ships) are over-estimated in the higher speed categories when applying the present Beaufort equivalents (WMO, 1972). Since most OWS winds are measured they will not be systematically over-estimated.

Results for the 5th percentile and median are qualitatively compatible with statements in the WMO reference, which asserts that lower wind speeds are underestimated by transient ships using the Beaufort scale. Indeed, the low speed winds are somewhat lower, or about the same, at the test areas.

PRECIPITATION

The rainfall data in figure 16 shows an apparent fair weather bias. The higher incidence of rainfall at the OWS's is consistent for nearly all locations and months. Because of its magnitude, this difference cannot be entirely explained by a simple avoidance of bad weather on the part of merchantmen. Though a detailed analysis has not been performed, some additional explanations are possible. For example, some observers may at times disregard light drizzle, or perhaps mistake certain precipitation situations for a fine sea spray.

VISIBILITY

Figure 17 shows the results of the visibility analysis. The ships in passage show a higher incidence of visibilities less than 2 mi than the Ocean Weather Stations. This phenomenon is fairly consistent for most months and OWS's. Some of the data were investigated for diurnal variation, but no trend was observed. The lower visibilities for the transient ships could be explained by the higher incidence of fog which occurs during calm weather conditions. Thus by avoiding high wind and wave conditions ships may be increasing their encounters with low visibility conditions.

The height above water of the observation platform may also be of some significance, as the OSV's bridges are somewhat lower than most merchant ship's.

Interpretation of these results is made difficult by the coarseness of the observing code, which permits only ten reportable visibilities. Cumulatively, these increments are <50 yd, <200 yd, <1/4 mi, <1/2 mi, <1 mi, <2 mi, <5 mi, <10 mi, <25 mi, ≥ 25 mi.

Since a shift of only one reportable interval makes a substantial difference in visibilities in the 1 to 5 mi range and since the observed frequencies are quite low the observed differences in visibility cannot be considered as significant as they may appear at first

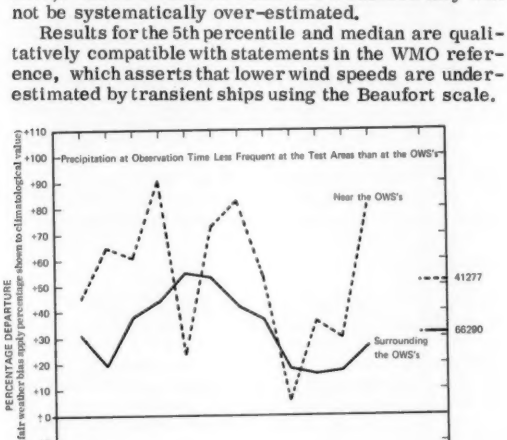
Precipitation at Observation Time Less Frequent at the Test Areas than at the OWS's
Near the OWS's
Surrounding the OWS's
PERCENTAGE DEPARTURE
(To obtain values adjusted for fair weather bias apply percentage shown to climatological value)
+110 +100 +90 +80 +70 +60 +50 +40 +30 +20 +10 ±0 -10 -20 -30 -40 -50
41277
66290
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
25.0 25.3 23.1 19.8 17.0 16.2 13.5 13.0 13.9 17.0 19.3 23.3 18.9 OBS
% Frequency of Precipitation at Observation Time - (ALL OWS's) 411192

Figure 16. --Percentage frequency of precipitation.

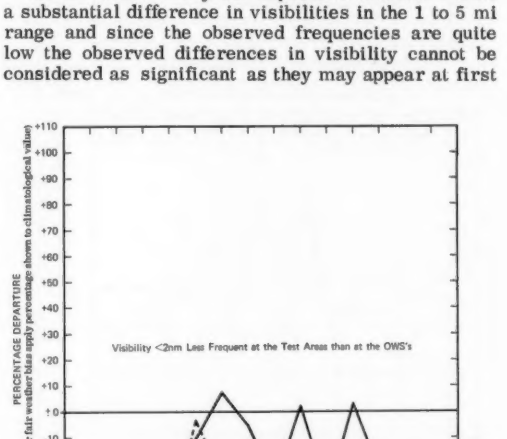
Visibility <2nm Less Frequent at the Test Areas than at the OWS's
Surrounding the OWS's
Near the OWS's
Visibility <2nm More Frequent at the Test Areas than at the OWS's
PERCENTAGE DEPARTURE
(To obtain values adjusted for fair weather bias apply percentage shown to climatological value)
+110 +100 +90 +80 +70 +60 +50 +40 +30 +20 +10 ±0 -10 -20 -30 -40 -50
68807
42161
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC ANN TOTAL
4.4 4.7 4.5 4.3 6.0 8.6 7.0 6.7 4.3 2.9 2.9 4.2 5.3 OBS
% Frequency of Visibility <2nm - (ALL OWS's) 413464

Figure 17.--Percentage frequency of visibility less than 2 mi.

glance.

CONCLUSIONS

Of the many factors thought to influence the overall quality of ship's weather observations, the fair weather bias appears to be a consistent phonomenon. This bias is probably of relatively little importance (except perhaps for precipitation) when dealing with routine climatological records. However, when dealing with observed extremes of the more extreme probability levels, it will usually be desirable to consider the fair weather bias, at least in a qualitative sense. By use of some of the foregoing charts it is even possible to estimate the quantitative impact of this biasing.

ACKNOWLEDGEMENTS

Support for this work was provided by the Naval Weather Service Command. Technical help was provided by many members of the staff of the National Climatic Center. Significant contributions were made by Ron Baldwin, Bob Courtney, John Snelling, Cecil Bradford and Frank Quinlan.

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Hints to the Observer

AIR TEMPERATURE AND DEW POINT

The air temperature and the dew-point temperature are two items used by the weather forecaster when he makes his evaluation of the weather situation. Temperature and dew point must be evaluated from the free air if they are to be of maximum value to the forecaster. Aboard ship, heat from the stack and from the ship itself can introduce errors into psychrometric readings unless proper precautions are taken. Psychrometric readings should be taken to windward in a shaded location. If the wick of the wet bulb is moistened 2 or 3 min before making the observation, it will cool to near its final reading, and less whirling of the psychrometer will be necessary. Whenever the apparent wind is 10 kt or higher, psychrometric readings can be made without whirling the psychrometer. Merely hold the thermometers into the wind until the wet-bulb and dry-bulb readings remain steady. Observers using the aspirated psychrometer can use the same technique by removing the plastic cover over the thermometer bulbs and holding the instrument into the wind. Operation of the fan is not necessary when the air movement past the thermometers is at least 10 kt.

Occasionally both bulbs will become wet from spray or rain. This will result in erroneous readings if the dry bulb is left moist. In these cases the dry bulb should be dried with a clean cloth and another reading should be taken. In very rough seas it may not always be possible to obtain an accurate reading from the windward side because of spray. When these conditions occur the observer should attempt to get the readings on the leeward side, making sure that the thermometers are kept away from any source of heat.

When the air temperature is near the freezing point, the wet-bulb temperature will, in many cases, be below 0°C. In these cases the wet bulb should be moistened 10 to 15 min before observation time and exposed to the free air. As the water evaporates from the wick the wet-bulb temperature will drop to 0°C and remain at that temperature for several minutes. Once the water in the wick has frozen and all latent heat has been dissipated the temperature of the wet bulb will drop below 0°C to the true wet-bulb value.

Additional Hints for Accurate Readings

1) Change the wick whenever it becomes soiled (at least once a week).

2) Be sure that the scale markings on the thermometers are legible. If they become difficult to read, have the Port Meteorological Officer replace them for you.

3) Apply clean water to the wick when moistening the wet bulb.

NOVEL INSTRUMENT SHELTER

This picture (fig. 18) of an unconventional instrument shelter on the AMERICAN TRADER, commanded by Captain David Dodge, was forwarded by David E. Harmon, the Port Meteorological Officer at Port Arthur, Tex. The shelter was designed and fabricated by a former unnamed mate. It is hoped that the unique shelter meets the requirements for a well-ventilated instrument shelter.

The PMO reports that the AMERICAN TRADER is an active participant in the cooperative meteorological program and has recorded and transmitted excellent weather observations over the past years.

Figure 18.--Captain Dodge of the AMERICAN TRADER shows the "bird house" instrument shelter.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS

Page 33--Monsanto (Lisbon), Portugal: Change frequencies to read "418, 4235, 6351.5, 8526, 13002, 17055.2, and 22551 kHz." Amend broadcast times to read "0550, 0800, 1150, 1750, 2000, and 2350." Information obtained from British Admiralty List of Radio Signals, Vol. III.

Page 35--Rome, Italy (IAR): Add frequency 4320 kHz/A1/10kw.

Page 41--Insert new station, Rio de Janeiro, Brazil (PWZ). Extracted from British Admiralty List of Radio Signals, Vol. III.

Station: Rio de Janeiro, Brazil (PWZ)
Area affected: [1]
(a) Coastal water of Brazil
(b) South Atlantic west of 20°W

Call sign	Time of broadcast	Frequencies (kHz)	Class of emission	Power (kw)
PWZ	0030, 0630, 1700	4290 6435 8550 12754 17160 22530	A1	2

Time of broadcast	Type of message	Contents
0030, 0630	Warnings	Warnings for areas a & b.
	Forecast	Forecasts for area a.
	Analysis	For area b, in code FM 46.D.
	SYNOP	Code FM 11.E.
	SHRED	Code FM 23.E.
1700	Warnings	For areas a and b.
	Situation	Synopsis for area b.
	Forecast	For area a.

[1] See figure 7.

Page 46--Cape Town, South Africa (ZSC): Add frequencies 4291 & 6423 kHz/A1/5kw.

Page 47 & 48--Coastal Radio Stations of Alaska:

(a) Add "NOX, Adak" to list of radio stations and insert the following at the bottom of the page: "0430, 2130; on receipt NOX/450/A1/Warnings only."
(b) Adak (NMJ21) - Change class of emission to A3H.
(c) Annette (KGD58) - Amend contents to read "Synopsis and forecasts for area 1 and Gulf of Alaska."
(d) Attu (NMJ22), Biorka Island (NMJ18), and Cape Sarichef (NRW) - Change class of emission to A3H.
(e) Cold Bay (KCI95) - Change broadcast time "0525" to read "0535."
(f) Juneau (KCI97) - Add broadcast time "0525."
(g) Ketchikan (NMJ) - Change class of emission to A3H.
(h) King Salmon (KC198) - Amend broadcast times to read "0215, 2015." Add note to the effect that the broadcast is available May - September.
(i) Kodiak (NOJ) - Insert preceding other data for the station: 0630, 1930/NOJ/470/A1/Synopsis and forecast for Gulf of Alaska.
(j) Nome (KCI94) - Delete broadcast times and insert in lieu of, "On request."
(k) Pt. Barrow (KCB53) - Delete broadcast times and insert in lieu of, "On request."

Page 71--Singapore (GYS): According to British Admiralty Notice 4-74, this broadcast has been cancelled.

Page 82--Durban, South Africa (ZSD): Change frequency 4337.4 to read "4377.4."

Page 103-Brentwood, N.Y. (WFH, WFK): Under "Frequencies," change time of 17436.5 kHz to read "1950-2350 GMT."

Page 106-Rota, Spain (AOK): Amend list of frequencies as follows:
7626, 8100, 12184 (0000-2400 GMT)
3713 (2100-0700 GMT)
5206 (2000-0800 GMT)
12903 (0800-2000 GMT)
15941.5 (0700-2100 GMT)
Under "Schedules," indicate that a schedule is transmitted at 0000 and 1200 GMT daily.

Page 109-Rio de Janeiro, Brazil (PWZ): Amend "Schedules" to read "0430, 1700." Amend "Map area" to read "10°N-35°S, 10°W to the South American coast."

Page 110-San Francisco, Calif. (WMM55): Change time of transmission to "2000-2100 GMT." Change content to read "Charts of significant interest to the southwest Pacific Ocean, including a surface analysis."

Page 112-Tokyo, Japan (JMH): Delete information listed under "Schedules" and "Map area" and replace with the following:

Schedules: Surface analysis (Map A) 0400, 1000, 1600, 2200;
24-hr surface prognosis (Map A) 0644;
Wave analysis (Map A) 0810;
Satellite (APT) mosaic (Map B) 0532;
Test chart 0521, 1320.

Map areas, projection, and scale:
A: 38.5°N, 65.5°E; 38.5°N, 145.5°W; 01°S, 112.5°E; 01°S, 167°E.
Polar stereographic projection, true at 60°N, scale 1:20,000,000.
B: 64°N, 78°E; 44°N, 151°W; 04°N, 100°E; 07°S, 168°E.

PUBLICATION U.S. AND FOREIGN COASTAL RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATION MESSAGES

Electronics Officer C. M. Airey, E. HORNSBY WASSON, has submitted a report that Mauritius Naval Radio (GXO) now accepts weather messages addressed to METEO MAURITIUS. Insert the following information on Page 18, following 3BA, Vacoas, Mauritius:

GXO Mauritius Naval Radio 8554 12831 (0000-2400)
"METEO MAURITIUS" 6393.5 17108 22533
(On request)
Location of station: 20-21S, 57-31E

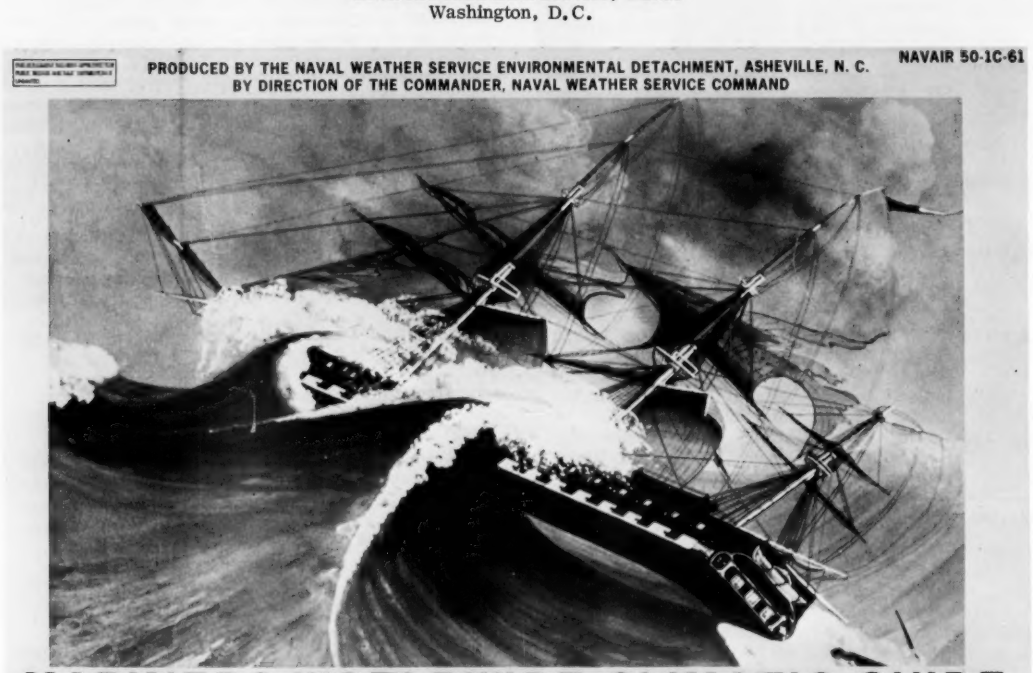
ACKNOWLEDGEMENT OF CORRESPONDENCE

The National Weather Service appreciated the information recently received from Mr. Airey, as mentioned above, and also that supplied by Radio Officer P. R. Garner (ship unknown) and Radio Officer George H. Anderson, CITRUS PACKER.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Hurricane Alley

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D.C.


PRODUCED BY THE NAVAL WEATHER SERVICE ENVIRONMENTAL DETACHMENT, ASHEVILLE, N. C.
BY DIRECTION OF THE COMMANDER, NAVAL WEATHER SERVICE COMMAND
NAVAIR 50-1C-61
MARINERS WORLDWIDE CLIMATIC GUIDE
TO TROPICAL STORMS AT SEA

THE $13.50 BARGAIN

One of the most complete climatic studies of tropical cyclones around the world is now available. It is called the Mariners Worldwide Climatic Guide to Tropical Storms at Sea, and is a U.S. Naval Weather Service Command publication, prepared by NOAA's National Climatic Center. The authors are Harold L. Crutcher and Robert G. Quayle of NOAA's Environmental Data Service. This is a special edition based on information extracted from data being compiled for updating the U.S. Naval Weather Service Command's series of Marine Climatic Atlases of the World.

The guide provides information on where and when tropical cyclones occur, their frequency, and general tracks. It consists of 114 pages of illustrated text and 312 charts covering 6 ocean basins, monthly and annually. The tropical cyclones are summarized by four stages, including tropical storm, hurricane or typhoon, a combination of these, and some stages that are not so well documented in specific basins. The chart information is in the form of tropical cyclone roses, which indicate frequency, direction of movement, and speed. The breakdown is by 5° squares. The text includes discussions on ship handling and tips on avoiding storms, as well as information on specific basins and tropical cyclones in general.

While this guide is designed for the mariner, its information will be valuable to the industrial and scientific communities. Here is a valuable reference book that brings together for the first time tropical cyclone statistics on all ocean basins. Up until now, information on the southern hemisphere oceans was almost impossible to find in this country. Now, it's all in the guide.

The Mariners Worldwide Climatic Guide to Tropical Storms at Sea, NAVAIR 50-1C-61, is available for $13.50 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO order number is 0319-00025.

TROPICAL CYCLONES

Tropical cyclone activity is infrequent in the southern hemisphere during May and June. Their winter season is starting. A few storms have formed in the Coral Sea and around the Malagasy Republic but they are rare. In the North Indian Ocean, spring is the second most active season next to autumn. An average of one tropical cyclone develops during May and June

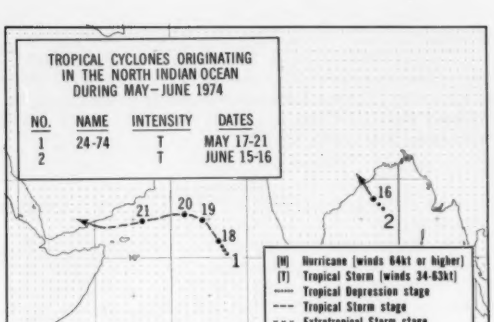


Figure 19. --North Indian Ocean tropical cyclones May - June 1974.

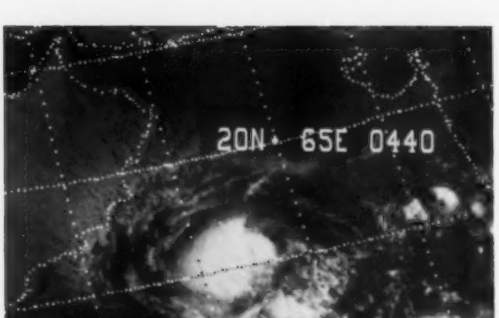


Figure 20. --Cloudiness from the tropical storm has already reached the Saudi Arabian peninsula early on the 19th.

and in this sense May and June 1974 were average in this basin.

This year's May storm formed in the Arabian Sea on the 17th (fig. 19). According to climatology these storms often move west-northwestward to the coast of Aden or Muscat and Oman. After a brief trek northwestward this May storm headed westward toward the Gulf of Aden. Winds near her center were estimated at 35 kt until late on the 20th when they climbed to about 50 kt. However, at 0000 on the 19th (fig. 20), the ENVI ran into 30-kt southwesterlies some 240 mi southwest of the center. Sometime on the 21st the storm's center crossed the Aden coast near Ash Shihr. There was no further tropical storm activity until nearly a month later.

On the 15th of June, close to the normal start of the monsoon season, a depression was sighted in the northern part of the Bay of Bengal. It developed during the day as it moved northwestward. By the 16th it reached tropical storm strength as winds near the center blew at 35 kt. However, the storm was too close to the coast to develop much more. A few hours later it moved inland over India near Gopalpur.

NORTH ATLANTIC SEASON OPENS

On August 13 the North Atlantic's first tropical storm was christened Alma. This was the latest start since 1967 when Arlene developed on the 28th of August. Over the past 30 yr seven seasons have started in August while one (1941) began in September. The annual number of tropical cyclones in these late-starting seasons range from five to thirteen.

Alma reached tropical storm strength about 450 mi east of Trinidad. She moved westward skimming the Venezuela coast. Her track is about as far south as North Atlantic tropical cyclones travel and is more reminiscent of off-season storms. The details of Alma will be covered in the Rough Log for August, appearing in the next issue of the Mariners Weather Log.

On the Editor's Desk

RESCUE AT SEA

The following item was obtained from the Military Sealift Command magazine, "Sealift."

"The twenty-third of April was a dismal day in the Marshall Islands of the South Pacific. Winds were 30 kt and there were 12-ft seas with 8-ft swells. Localized squalls had cut visibility to only 200 yd as the rain pelted anyone unlucky enough to be out in the weather.

"LCU 59 (landing craft, utility), a World War II vintage ship given to the Trust Territories following the war, was making her way toward Maja Island from Eniwetok Island carrying 60 tons of dynamite.

"The Micronesian crew did their best to keep the LCU on course as the heavy seas buffeted the 120-ft craft. But, at approximately 6:30 a.m., the LCU was swamped and started to roll over.

"The crew and passengers abandoned ship and took to four liferafts. Using an ultra high frequency (UHF) emergency transmitter, some of the men started sending distress calls which were picked up at the communications station on Kwajalein Island. Kwajalein radiomen notified an Army aircraft in the area that was diverted to the position the LCU crew had given.

"At 2:30 p.m., the Military Sealift Command-chartered 7,500-ton cargo ship AMERICAN RACER was heading for Kwajalein when the master received a message from the island base to change course and pick up nine people in a liferaft.

"After plotting an intercept course, the navigator of AMERICAN RACER estimated that they would reach the survivors within 3 hr if they continued at a top speed of 21.5 kt.

"An hour later, the AMERICAN RACER contacted

the Army aircraft and learned that there were 4 liferafts and 14 survivors instead of 9. The survivors included a woman and baby. After learning of their new position, the navigator estimated the RACER would reach the rafts at 6:30 p.m.

"At 5:20 p.m., the AMERICAN RACER crew picked up the Army aircraft 11 mi away on the ship's radar. Thirteen minutes later they sighted the plane. The pilot flew directly over the liferafts and turned on the aircraft landing lights to show the AMERICAN RACER the exact position of the lifeboats since they were hidden by swells.

"The AMERICAN RACER crew hung a 40-ft net over the starboard side along with two Jacobs ladders, boat ropes and heaving lines. Capt. Lawrence Pagano maneuvered his ship windward of the rafts and drifted toward them. The aircraft crew informed the survivors of the captain's intentions and at 6:12 p.m. the crew started helping the survivors aboard.

"'The only real problem we had,' said Captain Pagano, 'was that one of the survivors was an 18-month-old infant and quite naturally was terrified and clutching his mother, making it difficult to get him aboard.'

"'The problem was solved quickly when four able-bodied seamen climbed down the pilot ladder and passed the baby man-to-man up to the deck.'

"The entire rescue took only 17 min. 'No individual did anymore than his routine job and it was a beautiful team effort,' said Captain Pagano. 'Our greatest accomplishment was that there were no injuries or loss of life.'

"The captain praised the aircraft crew saying, 'I can't give enough credit to that Army plane. They were like homing pigeons leading us directly to the liferafts. Without them, finding the survivors in that sea would have been just dumb luck.'"

OCEAN STATION VESSELS BRAVO AND NOVEMBER PHASED OUT

The Coast Guard ended its 34-yr-old Ocean Station Program on June 30, when the last two mid-ocean weather stations still in use, "BRAVO" in the Atlantic Ocean and "NOVEMBER" in the Pacific, were closed.

The closing of "BRAVO" and "NOVEMBER" completed an earlier announced schedule for discontinuing the program. In 1973, other Atlantic Ocean Stations, "DELTA" (1,000 mi south of Greenland) and "CHARLIE" (halfway between Labrador and Ireland), were closed. Discontinuing the program is expected to save an estimated $17 million annually.

Originally developed to assist aircraft in trans-oceanic flights and to provide weather and navigational data to vessels and shore bases, the patrols had become obsolete with the advent of sophisticated jet aircraft and communications satellites.

Since 1940, the Coast Guard has been maintaining cutters on ocean stations in the Atlantic and Pacific. In addition to the cutters' roles as navigational aids and data collection platforms, several search and rescue missions conducted by cutters on ocean station

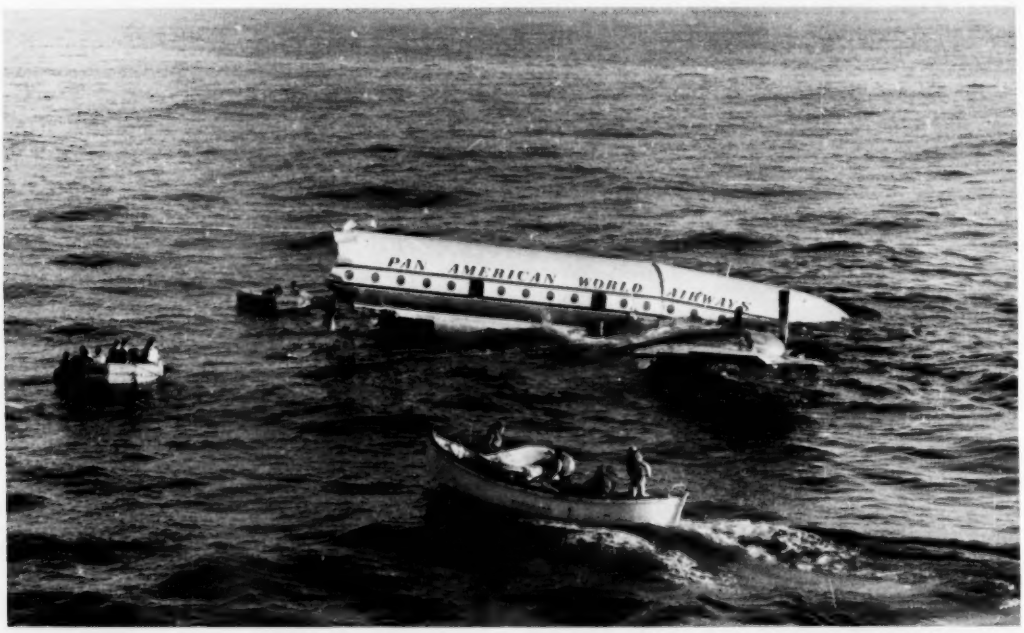


Figure 21.--The USCGC PONTCHARTRAIN on duty at Ocean Station "November" rescues the passengers and crew from an aircraft that ditched at sea. U.S. Coast Guard Photo.

Figure 22.--The crew of a Coast Guard Cutter fights high waves and ice while on duty at Ocean Station "Bravo." U.S. Coast Guard Photo.

have strengthened the agency's legacy as "lifesavers" Among the rescues most publicly noticed were the 1947 rescue of the 62 passengers and 7 crewmembers of the downed flying boat "Bermuda Sky Queen" by the USCGC BIBB on Station "CHARLIE" and the 1956 rescue of 31 persons on board a Pan American plane which went down near the cutter PONTCHARTRAIN on Ocean Station "NOVEMBER" (fig. 21).

On July 5, Coast Guardsmen and Coast Guard cutters that have served on ocean station patrols were honored by United Air Lines at ceremonies held aboard CGC MELLON in Honolulu. The ceremonies were held "commemorating 34 yr of 'Lifeguard' duty to the airlines of the world."

The two Coast Guard Cutters which were assigned to the last 3-wk long patrols were the 378-ft High Endurance Cutters MELLON and MORGENTHAU. MELLON, homeported in Honolulu, Hawaii, patrolled "NOVEMBER" in the Pacific, midway between San Francisco and Honolulu. The New York based MORGENTHAU drew the last "BRAVO" patrol, halfway between Labrador and Greenland.

As a result of the phasing out of ocean stations, the Coast Guard has decommissioned ten High Endurance Cutters since June 1973. Ocean Station Patrols were a major function of the HEC's.

With the end of Ocean Stations, High Endurance Cutters will continue to be used in many of the other missions of the Coast Guard, specifically, search and rescue and fisheries patrols.

Weather station "HOTEL", located 250 mi northeast of Norfolk, Va., is not a part of the ocean station program and will continue. "HOTEL" is manned by a cutter from August to mid-April to provide advance weather data on winter storms and hurricanes heading for the eastern seaboard.

Editor's Note: The Mariners Weather Log would like to express its appreciation, and we are sure that of all other meteorological operations, to the Coast Guardsmen and National Weather Service observers who manned these stations in all kinds of weather and hazards. Where other ships usually much larger, could change course to avoid at least the worst part of a storm, these ships remained on station to measure and disseminate the weather conditions no matter how severe, or aid ships and aircraft with navigation and communication problems, or in emergency situations (fig. 22).

NOIC AND NDBO TESTING OCEAN WAVE MEASURING INSTRUMENTS

How high are the waves in the ocean? How fast do they move? With what impact do they strike the shore? What effect do they have on weather? Pollution? Coastal structures? Offshore oil platforms and deepwater ports?

The National Oceanographic Instrumentation Center (NOIC) and NOAA Data Buoy Office (NDBO) are testing instruments which may one day help furnish the answers to questions that have puzzled man for centuries.

NOIC recently tested eight wave-measuring instruments, ranging from bottom-mounted acoustic devices to large vertically oriented electrical cables, in the Pacific Ocean off Scripps Institution of Oceanography at La Jolla, Calif. The cost of such instruments varies from $500 to $50,000. Results of the tests will be presented at a symposium in New Orleans in September.

Along with the testing of wave-measuring devices, NOAA is experimenting with a wave-measuring system installed by the NDBO on an experimental buoy (EB-13) moored in the Atlantic Ocean in 12,600 ft of water about 300 mi east of Charleston, S.C. The wave parameters, period, and length of the waves, are reported to a shore data-collection station every 3 hr.

The system has transmitted ocean-wave data regularly since the buoy was deployed last December 10. The measurements are being compared at the NDBO facility near Bay St. Louis, Miss., with ship reports from the area of the buoy position and are being analyzed also on the basis of wind measurements from the buoy. Both the wave-measurement technique and the reliability of the equipment are being evaluated for use on future buoys.

The Army Coastal Engineering Research Center at Ft. Belvoir, Va., and the Naval Research and Development Center at Carderock, Md., have continuing requirements for wave-height data and consequently have been developing and testing improved measurement techniques for a number of years. NOIC has teamed up with these agencies to conduct joint tests of ocean-wave measuring instruments from an ocean platform tower in the Gulf of Mexico near Panama City, Fla.

The devices tested, which showed a wide diversity and ingenuity in design, included wave staffs or poles with electrical resistance varying with wave height; transducers on the ocean floor which measured ocean pressure changes as the waves passed; sonar-based systems which measured wave height as time of travel of underwater acoustic pulses reflected from the ocean surface; sonic systems which directed a beam of high-frequency sound waves down at the ocean surface; photographic records of waves moving past a vertical pole with heights marked on it; closed-circuit television records of motion of a floating vertical pole (sparbuoy); and records from frequency-modulated (FM) radio transmissions from a new design of wave-measurement buoy.

Simultaneous measurements from the different systems were recorded on magnetic tape for processing and analyzing by a digital computer at the Naval Ship and Development Center.

It is hoped that scientists and program managers will put this knowledge to work and ultimately it will help prevent the erosion of our beaches and assist in the building of piers, bulkheads, and beach structures that will be better able to withstand the force of the ocean waves. And from knowledge gathered of mid-ocean waves, ships can be better protected against damage and assisted in the routes they take.

Scientists are also interested in the mixing effects of waves, how they relate to the dispersion of pollutants, and how waves interact with the weather.

1900-KM-WIDE OCEAN CURRENT IS DEEP AND SLOW

A sluggish current of cold water flows in a 1,900-km (1,025-mi) wide front from Antarctica to the northern hemisphere, say scientists back from a 56,000-km (30,000-mi) research voyage. The scientists docked at Scripps Institution of Oceanography after a 10-mo Pacific cruise, part of the National Science Foundation's $16 million geochemical ocean sections study.

The current is thought to have a major effect on world climate because it regulates the temperature of surface water, which influences air temperature. The cold water also carries up ocean-floor nutrients vital to sea life. In addition, knowledge of the current is considered necessary for any possible future disposal of radioactive wastes or other pollutants in the ocean depths.

The current, with an average temperature of 33.8°F (about 1°C), begins at a depth of 2,600 m (8,500 ft) and extends another 2,600 m deep in places. The speed of the current varies from one-fifth to four-fifths of an inch per second (1/100 - 1/25 kt), and water takes 1,000 yr to flow the entire distance.

The key finding of the voyage was the extent of the cold current, previously thought to be confined to a swift-flowing, narrow band east of New Zealand. That flow is a small part of the larger current, which flows up the middle Pacific with arms reaching to Hawaii and Japan, covering an area of about 10,240,000 sq km (4,000,000 sq mi).

Scientists will spend more than 2 yr analyzing 25,000 gallons of water collected during the voyage. A similar trip has been made to the Atlantic, and a third is planned for the Indian Ocean.

NOAA AND NATIONAL SAFE BOATING

The National Oceanic and Atmospheric Administration announced that it hopes to place its automated hydrographic data bank in operation for the Gulf of Mexico in another year.

The Gulf will be the first area in the nation to have nautical chart data computerized. Automation of data for all of NOAA's 971 nautical charts is scheduled for 1980. The charts cover U.S. coastal waters and various inland waterways and lakes, including the Great Lakes. Approximately 2.2 million charts of America's domestic waters are issued each year.

The announcement coincided with the observance of National Safe Boating Week. The data bank program is one of a number of programs taken to promote boating safety and assist recreational boaters, fishermen, and commercial shipping by NOAA.

The creation of a data bank involves converting all necessary information to magnetic memory storage in computer language. It is the first step in the establishment of a largely automated system for producing nautical charts. Under a 10-yr, $25 million program, the data for all areas covered by National Ocean Survey, which produces the charts, will be established in the

data bank at the Survey's Rockville, Md., headquarters.

When completed, the bank will include nautical data for 90 charts of the Gulf area. The data will include soundings (water depths); prominent landmarks and radio beacons which enable mariners to fix their position at sea; channel limits; bottom characteristics (sand, gravel, clay, mud, etc.) and bottom contours; Coast Guard aids to navigation, such as buoys and lightships; underwater cables and pipelines; submerged navigational hazards, such as wrecks, remnants of abandoned oil derricks and shoals; restricted military areas; safety shipping lanes; and ship traffic separation lanes for ports.

The National Ocean Survey is also updating approximately 500 of its charts in the next year to help promote the safety of the nation's 50 million boaters. New information for this purpose is being constantly gathered by hydrographic survey vessels and through the cooperative efforts of members of the U. S. Power Squadrons and the U. S. Coast Guard Auxiliary and from other government and private sources.

The Survey is also adding Loran C, an improved electronic navigation aid to some charts. Where appropriate, Loran C will be printed on one side of the chart and Loran A, an older electronic navigation system, on the reverse side.

In the Great Lakes, Lake Survey Center furnishes boaters with vital information on lake water levels, which can vary from those published on nautical charts by as much as 4 ft or more during fluctuating high waters. The difference between actual and charted depths can be obtained from the Lake Survey Center, Federal Bldg., Detroit, Mich. 48226, from the agency's free Monthly Bulletin of Lake Levels.

A key role in the program to enhance boating safety is carried out by the National Weather Service. This agency prepares forecasts for shore areas of the U. S. every 6 hr. oftener when conditions change rapidly. Forecasts cover specific coastal areas, such as Block Island, R. I., to Manasquan, N. J. When strong winds or hazardous seas are anticpated, these forecasts include statements of the degree of hazard and the areas where warning signals will be displayed. Similar forecasts and warnings are issued for many inland lakes, reservoirs and waterways.

Boaters receive pertinent weather information over commercial radio and TV. Most stations in coastal regions make a special effort to answer the needs of boaters and shipping in their weather forecasts.

In a growing number of shore areas, weather information can now be received through VHF-FM radio stations operated by the National Weather Service. The 65 stations in operation are on the air continuously, repeating taped weather messages every 4 to 6 min. Tapes are updated periodically, usually every 2 to 3 hr, and revised also to meet fast-changing weather. Special receivers or tuners are required since the weather forecasts are made on 162.55 or 162.40 MHz, considerably above commercial FM frequencies. Such receivers are now available at prices ranging from $20 to $200.

The National Weather Service has also established a more widespread distribution of its "Marine Weather Services Charts," which list for various coastal areas and the Great Lakes information on how to obtain up-to-date weather information. These charts are now available from the National Ocean Survey's 1,087 nautical chart sales agents.

The National Marine Fisheries Service will make available again to commercial fishing vessels safety placards on how to deal with emergency medical problems at sea. The placards will deal with the evacuation of crew members and passengers from vessels in distress and individuals requiring immediate medical attention and will advise vessel operators how to obtain medical advice for ailing personnel or passengers. The placards will be suitable for posting aboard vessels.

CHINESE JUNK SETS SAIL FOR SOUTH AMERICA

The eight-man crew of a replica of a 2,000-year-old Chinese junk set sail from Hong Kong, Tuesday night, June 18, after waiting for more than 2 wk for the right winds to carry them on a planned 6-mo journey to South America.

The crew of the 16-meter-long Tai Ki (the great one, the all) left at 7:30 p.m., during a letup in a heavy downpour. The six-nation crew had been waiting for southwesterly winds.

The Tai Ki, which has rattan sails, will wend its way toward Taiwan and Okinawa. From there, at an average speed of about 6.5 km/h (3.5 kt), the crew plans to head east toward the northern California coast and then south to Mexico or Peru, the end of the journey, according to Carl Frederick Grage of Copenhagen, captain of the pinewood ship.

Kuno Knobl, a 37-year-old Austrian journalist who initiated the Tai Ki project, has said the purpose of the trip is to prove that Chinese sailors 2,000 yr ago had the ships and navigating ability to sail to South America. Traditional historians, on the other hand, have argued the advanced civilizations of Central and South America developed without contact with the rest of the world until the arrival of European explorers.

NEW GREAT LAKES LABORATORY

This summer, the National Oceanic and Atmospheric Administration puts all its Great Lakes researchers into one laboratory. The Great Lakes Environmental Research Laboratory, is to be located at Ann Arbor, Mich. The new laboratory brings together scientists from the National Ocean Survey's Lake Survey Center in Detroit and researchers working on the International Field Year for the Great Lakes (IFYGL). The scientists will move in late this summer.

The Great Lakes laboratory is the newest partner in NOAA's Environmental Research Laboratories, based in Boulder, Colo. At the laboratory, some 30 scientists will investigate the total lake ecology, from the sediments below the water to the air above.

IFYGL will be the main item on the Great Lakes laboratory agenda for the first few years. The project is an ambitious joint effort between the United States and Canada to collect, analyze, and manage massive amounts of data on one of the lakes the two nations share -- Lake Ontario. Beginning in April 1972, some 600 United States and Canadian scientists and technicians spent a year collecting reams of data about Lake Ontario. But that was just the beginning of the six-phase project. The job of analyzing the data will occupy the scientists until 1977. In addition to scientists from the IFYGL Project Office, about a third of the scientists from the Lake Survey Center are engaged in IFYGL work. It is estimated that for the next couple of years, two-thirds to three-fourths of the new lab-

oratory's efforts will be occupied with IFYGL.

In the longer view, some of the projects and goals of the Great Lakes laboratory have been mapped out. The research will have two emphases. Basic research will contribute to the background of general knowledge about the lakes. Other projects are problem-oriented, aimed at solving specific problems or meeting specific needs, such as improving navigation, preventing erosion, pollution, or predicting changes in lake water levels.

One of the main goals of the lake laboratory will be a comprehensive model of lake circulation -- how the water circulates in response to the natural forces acting upon it. Existing models are in early stages of development, dealing with the effects of surface wind and heating. The scientists in the Great Lakes laboratory are developing a hierachy of models that includes every conceivable facet and factor, such as wind stress, differential heating and cooling, inflow of water from tributaries, seasons, and the shape of the lake.

Some of the Great Lakes harbors are plagued with unpredictable currents that call for tricky navigation. Toledo Harbor, which has particularly troublesome currents in its entrance channel, is already under study. The researchers hope to produce a device that will show the direction and speed of these currents at any given time.

The group will also study the most familiar type of water motion -- waves. Wave action may erode the shoreline in one place and build it up somewhere else. Data on waves can be used to predict wave-induced changes in the shoreline. Surface waves are a hazard to navigation -- especially for recreational boating. Wave data must also be considered in designing ships and shoreline structures. Present wave theories are based largely on observations from the oceans, where waves may travel great distances without obstruction. The situation on the lakes is quite different. The researchers are developing models to predict wave conditions from meteorological conditions and lake geometry.

Other studies will focus on lake climatology, winter ice, lake hydrology, the population dynamics of key organisms, and water quality in the various bays, rivers, and harbors.

To accomplish these goals, the scientists will work in the laboratory and the lake. The facilities at Ann Arbor include laboratories for water chemistry and sediment studies, and ice laboratory with a storage room kept at -30 degrees Celsius for close-up looks at ice, and a biology laboratory for analysis of samples collected in the field and for observing the effects of environmental changes on selected species. A lakeside facility will provide a starting point for field research. For research on the waters of the lakes, the limnologists will use NOAA's 65-ft research vessel, SHENEHON, operated by the Lake Survey Center.

The Great Lakes are sources of water, power, supplies, and pleasure for millions of Americans. Major industrial centers line their shores. But the many uses of the lakes are also creating some of their problems. If the lakes are to be both exploited and preserved, they must be skillfully managed, and the necessary skill can come only from a more complete understanding of the lakes. The NOAA Great Lakes scientists, from their new laboratory in Ann Arbor, hope to provide that knowledge.

COAST GUARD TO ENFORCE NEW POLLUTION PREVENTION REGULATIONS

The U. S. Coast Guard, tasked with the responsibility of preventing maritime pollution, reminds all mariners of the new pollution prevention regulations that went into effect on July 1 of this year.

The new regulations are designed to minimize the possibility of accidental spills of oil into the water during normal vessel operations or during the bulk transfer of oil or oily waste between vessels and between vessels and shoreside facilities.

Vessels that have a capacity of carrying 250 or more barrels of oil or oil by-products are subject to the new regulations. The regulations also apply to any shoreside transfer facility which services a vessel of 250 barrel capacity. Oil tank trucks and railway tank cars are included in the definition of transfer facilities if the vessel which they are servicing meets the 250 barrel or more criteria.

Also effected will be the recreational boater. The regulations require that all vessels must have a means to discharge oily bilge slops to a reception facility. Further, recreational boat or vessel operators in general are prohibited from draining any oil into the bilges of his vessel.

To remind operators of the prohibition of draining oil into the bilges, all vessels 26 ft or longer must display a placard in the machinery spaces or at the bilge and ballast pump control station stating the following: "The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste into or upon the navigable waters and contiguous zone of the United States if such discharge causes a film or sheen upon, or discoloration of, the surface of the water, or causes a sludge or emulsion beneath the surface of the water. Violators are subject to a penalty of $5,000."

As a public service to their clients, many marine insurance companies are printing a limited number of the required placards and making them available to the boating public through the Coast Guard.

The Oil Pollution Prevention Regulations were drafted as a result of the Federal Water Pollution Control Act (33 USC 1321). Section 311 of that act prohibits the discharge of "harmful quantities" of oil into or upon the navigable waters of the United States, the adjoining shore-lines, or into or upon the waters of the contiguous zone. Additionally, any person in charge of a vessel or facility shall, as soon as he has knowledge of any discharge of oil from such vessel or facility, immediately notify the Coast Guard of such discharge.

Under the authority of the FWPCA, the Environmental Protection Agency has defined harmful quantity of oil to mean: that which (1) violates applicable water quality standards, or, (2) causes a film, sheen, discoloration, sludge, or emulsion to be deposited into or upon the water or upon adjoining shorelines. (Title 40, Code of Federal Regulations, Part 110).

The owner or operator of any vessel or facility from which a harmful quantity of oil has been discharged is subject to a civil penalty of not more than $5,000. Also, failure to notify the Coast Guard of a discharge may result in criminal court action with the possibility of receiving a fine of up to $10,000 and/or imprisonment of up to 1 yr.

The civil penalty provision is administered by the Coast Guard with the law requiring that where a dis-

charge occurs and a polluter is identified a civil penalty must be assessed. The Coast Guard does not have the discretion to limit the penalty to a letter of warning or take into account the actions of the polluter in cleaning up.

The regulations in their final form are contained in Parts 154, 155, and 156 of Title 33 of the Code of Federal Regulations. Details may be found in the December 21, 1972 issue of the Federal Register.

Additonal information may be obtained from the nearest Coast Guard District Office, Captain of the Port Office, or Marine Inspection Office. Recreational boaters may contact their nearest Coast Guard unit or Coast Guard Auxiliary Flotilla.

FIRST WOMAN CREW MEMBER ABOARD A NOAA VESSEL

Rose M. Wright (fig. 23), of Coulee Dam, Wash., has reported aboard the NOAA Ship OCEANOGRAPHER as the first woman crew member in the 25-vessel NOAA Fleet. The vessel is conducting oceanic research off the coast of west Africa.

Miss Wright joined the flagship of the NOAA Fleet in Miami, Fla., as a Yeoman Assistant and is serving as the ship's storekeepter, issuing parts and supplies, maintaining inventories and lists of suppliers,and handling purchase orders.

Aboard the 303-ft, 3,800-ton oceanographic floating laboratory, Miss Wright joined two other women, both NOAA commissioned officers, Ensign Francesca M. Cava and Ensign Deborah A. Astle. Like all crew members, Miss Wright is a civil service employee. There are 10 women officers in the NOAA Commissioned Corps.

The OCEANOGRAPHER is participating in the Global Atmospheric Research Program Atlantic Tropical Experiment (GATE). The experiment, in which vessels and aircraft from ten nations are participating, is gathering information on the atmosphere's mechanisms for moving heat from the Equator to the cooler regions of the earth, including the poles. Knowledge of how this heat transport takes place is fundamental to forecasting weather a week or more ahead with reasonable accuracy. During the experiment, the OCEANOGRAPHER will be stationed about 600 mi (1000 km) off the west coast of Africa. The ship is scheduled to return to her home port of Seattle in mid-October.

Figure 23.--Yeoman Assistant Rose M. Wright.

LETTERS TO THE EDITOR

APPRECIATION FOR SHIPS' WEATHER OBSERVATIONS

Arthur R. Thomas, Meteorologist in the Upper Air Branch of the National Meteorological Center, NWS, sent the following letter to Arnold R. Hull, Associate Director for Climatology, Environmental Data Service.

"I want to take this opportunity to express my sincere appreciation for the Mariners Weather Log. As a Quality Control Meteorologist with a vested interest in ships' weather reports required for operations here at the World Weather Center in Washington, your publication provides insight and understanding of the many problems and hardships persevered by the shipboard observers in taking the observations and providing the data. Clearly, the Log consistently illustrates that much of the needed ship data are obtained only because the marine observers possess deep interest in and great dedication for the program. Moreover, the illustrations and descriptive narrative contained in the Smooth and Rough Logs of the publication add that dimension essential for vividly envisioning actual weather conditions which can never be fully comprehended by merely scrutinizing weather maps or satellite pictures. This gives us a greater appreciation for the data we do obtain. It also provides much better comprehension into the reasons why the data may not be available sometimes."

DATA BUOY EB-02 ESTABLISHED IN THE PACIFIC

Commander R. A. Johnson, Commanding Officer of the USCGC YOCONA, sent the following letter concerning the deployment of Data Buoy EB-02 off the U.S. west coast, by the YOCONA. See page 248 of the July 1974 issue of the Mariners Weather Log for additional information on data buoys and EB-02.

"NOAA Data Buoy EB-02 (fig. 24) was established 290 mi west of the mouth of the Columbia River by the U.S. Coast Guard Cutter YOCONA on May 30, 1974. The buoy is 18.5 mi north-northwest of the Cobb Seamount and is moored in 1,650 fathoms. The buoy previously spent 7 mo on station in the Gulf of Mexico. The buoy was modified slightly, overhauled, trucked to Seattle in three parts, reassembled, and towed to station.

"The 'E' designation originally was to indicate that the buoy was an experimental or evaluation model. While part of the purpose in mooring this particular buoy in the Pacific is for further evaluation, it will provide real and important weather information. Of immediate interest to mariners and those along the coast who depend upon accurate forecasts is the fact that the National Weather Service will have a fixed 'ship reporting station.' This station will be about 12 weather hours off the coast and will provide good information on approaching frontal systems which largely govern and plague the Oregon-Washington coastal weather.

"Ultimate plans for data buoys in the Pacific call for 12 buoys to be located in the Bering Sea, Gulf of Alaska, and North Pacific. Seven of these will be along the route of the Marine Leg of the Trans-Alaska Pipeline -- the route from Valdez, the southern end of the true pipeline, to the refineries in Washington and California. Better forecasts should mean less ship damage and less pollution by oil escape.

"EB-02 joins the first Pacific data buoy, EB-03, which was placed in the Gulf of Alaska in the fall of 1972. The buoys belong to NOAA and are set, serviced and recovered by the U.S. Coast Guard. The buoys are equipped with sensors to measure wind speed and direction, atmospheric pressure, precipitation, temperature, and wave/swell height and period. The information is processed by a small computer and transmitted ashore to the Coast Guard Communications Station at San Francisco. The onboard generators and fuel supply will allow the buoy to function for about 1 yr."

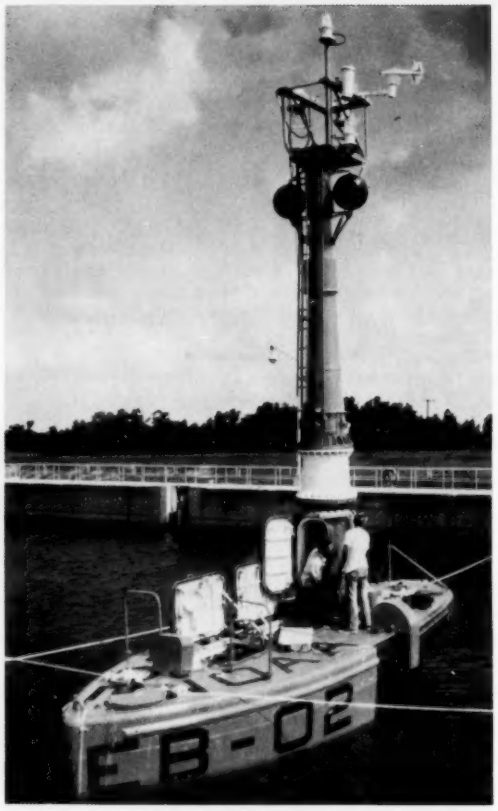


Figure 24.--An idea of the size of the data buoy can be obtained by comparing the height of the man with the tower.

MESOSCALE STORM AT SEA

A very interesting letter was received from Deck Cadet Kevin Morley of the EXPORT ADVENTURER, concerning a sharp dip in the barogram on July 18, 1974 near 39.6°N, 55.9°W.

"On July 18, 1974, during a westbound crossing of the Atlantic from the Azores, the EXPORT ADVENTURER encountered a severe and unexpected fluctuation in the weather. There had been no warnings in any of the weather reports received that day.

"The ship was in a plus three time zone. The accompanying barogram (fig. 25) shows the barometric pressures throughout the period. There is no appreciable error in the barograph. The course was 271°. Speed was 17.5 kt until the rough seas were encountered (table 4)."

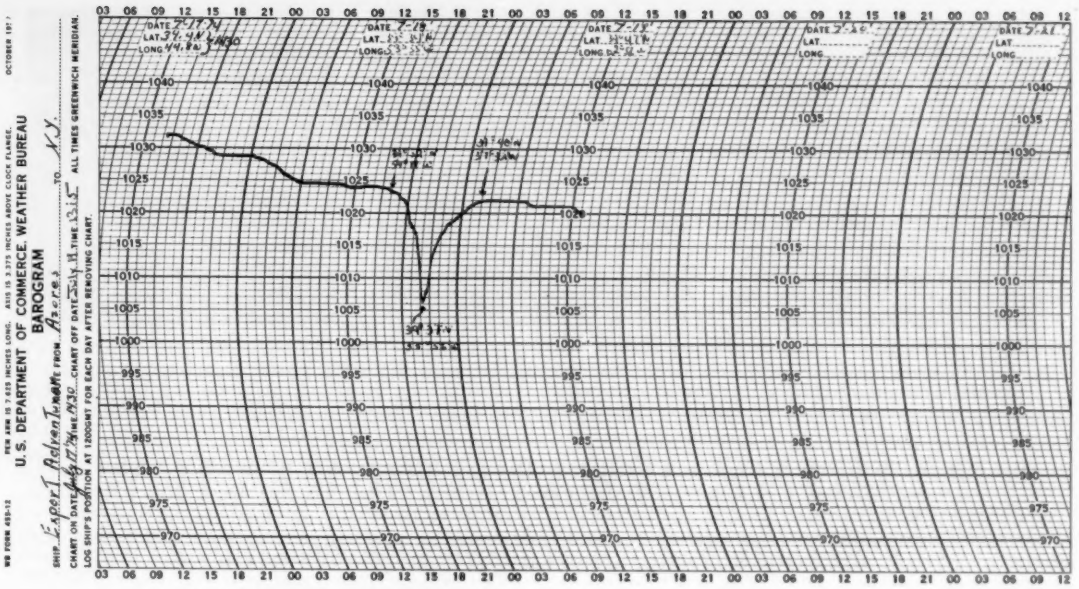

U.S. DEPARTMENT OF COMMERCE, WEATHER BUREAU
BAROGRAM
WB FORM 485-12
OCTOBER 1957
ALL TIMES GREENWICH MERIDIAN.
CHART OFF DATE July 19 TIME 0330
LOG SHIP'S POSITION AT 1200GMT FOR EACH DAY AFTER REMOVING CHART.
SHIP Export Adventurer
03 06 09 12 15 18 21 00

Figure 25. --Barogram trace showing the sudden drop in pressure experienced by the EXPORT ADVENTURER.

Table 4. --The weather parameters as recorded by the EXPORT ADVENTURER from 1900, July 18 to 0300, July 19.

Local Time	Wind Direction	Wind Force	Barometer	Air Temperature	Water Temperature	Sea Condition
1600	SE	4	30.06	78°	79°	
1700	SxW	9	29.94	76°		Moderate
1730	SW	9	29.84	75°		Rough
1800	WxS	9	29.74	74°		Confused
1830	NWxW	7	29.88	74°		Rough
1900	NNW	6.5	29.99	73°		
1930	NxW	5	30.01	72°		
2000	NxW	5	30.03	72°	79°	
2100	NxW	5	30.07	72°		
2200	N	3	30.12	71°		
2300	NNW	3	30.16	70°		
2400	NNW	2	30.15	68°	73°	

Editor's Note: This LOW was associated with a frontal trough that moved off the U.S. east coast late on the 16th. At that time, it was beneath and parallel to the wind flow on the east side of the upper-air trough. The upper-air trough was quasi-stationary near the East Coast. Frontal waves were forming off Cape Hatteras and dissipating as they moved northeastward along the front. Their lifespan was 6 to 12 hr.

A 1016-mb wave was analyzed, near 39°N, 58°W, on the 1200 chart of the 18th. The 1800 chart indicated a 1018-mb wave near 39°N, 58°W. The 0000 chart of the 19th had a 1020-mb wave near 40°N, 55°W. The WSFO Washington, D.C. Marine Forecast released at 1645 valid beginning at 1800 on the 18th mentioned this specific LOW and forecast it to move northeastward at 30 kt. The winds were forecast for 20 to 30 kt and gusty near the LOW. The sparcity of data precludes a definite statement on whether these were the same or different waves but my best guess would be that they were not the same, and were coincidentally in the same area at synoptic times. The waves were also being monitored by the National Hurricane Center for subtropical LOW characteristics and development (fig. 26).

The winds reported by ships in the general area were 10 to 20 kt with one 25-kt wind near the center (100 mi away) at 1800. The barograph from the EXPORT ADVENTURER shows that the storm was much more intense than the plotted data indicated. Satellite pictures indicate a small intense storm.

Figure 26.--Satellite photographs on July 17, 18, and 19, 1974 show the meso-LOWs moving rapidly northeastward along the front.

MARINE WEATHER REVIEW

Smooth Log, North Atlantic Weather

March and April 1974

The SMOOTH LOG (complete with cyclone tracks [figs. 27-30], climatological data from U.S. Ocean Station Vessels [tables 5-6 and 8] and gale tables 7 and 9), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, MARCH 1974--The number of storms and their tracks were near normal this month, but they were more intense, with lower pressures in the mean. There was also a tendency to be more concentrated in the path toward the Denmark Strait, south of Greenland and Iceland. The storms in the Mediterranean Sea were near normal, but shifted more to the west, with several off the coast of Portugal and Morocco.

The 30-day mean sea-level chart was normal in appearance, but the central pressures were more extreme. The 1005.3-mb Icelandic Low at 993 mb was located about 100 mi south of Kap Farvel, slightly west of its climatological position. The Azores High was 5 mb higher than the mean, at 1025 mb, and near its normal position.

The major departures were associated with pressure centers. A negative 13-mb anomaly was centered near 60°N, 50°W, just west of the Icelandic Low, and reflected its lower pressure and western displacement. A negative 11-mb anomaly center over Baffin Bay resulted from a deeper and sharper trough in that area. A negative 4-mb anomaly was located over the western Mediterranean Sea. The major positive anomaly was 15 mb over northern Scandinavia. A ridge of the Siberian High pushed into the Norwegian Sea, where normally a trough of the Icelandic Low is located. The higher pressure of the Azores High resulted in a positive 6-mb anomaly near its center.

There were no tropical cyclones this month.

On the 4th, a LOW was located east of Kap Farvel with a front extending southward along 25°W. A secondary trough developed west of the front, resulting in a weak area in the gradient. At 1800, a 1002-mb LOW developed in this area of weak gradient. By 1200 on the 5th, the LOW was at 41.5°N, 25°W with a pressure of 996 mb. The JOSEPH LYKES at 35.3°N, 26.8°W was pounded by 50-kt winds. Six hours later, the SEA-LAND ECONOMY at 39.7°N, 26.8°W measured 55-kt winds supporting 20-ft seas and 32-ft swells.

The southwest quadrant of the LOW was a rough place to be. At 0000 on the 6th, the BELVAL, near 39°N, 26°W, was sailing southward with northwest winds of 55 kt and 33-ft seas. The storm stalled in that area for 12 hr before starting a southeasterly track. As it moved southward it started filling and crossed the coast of Morocco, on the 8th, to dissipate over the

Atlas Mountains.

A weak, diffuse depression crossed the Rocky Mountains from the Pacific. In the vicinity of Lake Winnipeg on the 6th, it consolidated and intensified. The pressure was 989 mb. In its eastward movement, it gained in circulation, but did not deepen until over Newfoundland on the 8th. At 0000, the DAWSON was near 42.5°N, 63°W, and was hit by 40-kt winds and 16-ft swells. Twelve hours later, at 1200 on the 8th, the POSEIDON, near 51°N, 45°W, found 50-kt gales and 23-ft seas, but they were not enough for an adventure. Several ships both southeast and southwest of the center reported gale-force winds. The SEALAND VENTURE measured 45-kt winds at 38.8°N, 38.8°W.

By 0000 on the 9th, the 956-mb LOW was centered near 53°N, 45°W. The pressure had plunged almost 1 mb/hr over the last 24 hr. The Ukrainian ship USNG, 360 mi due south of the center, was battered by 60-kt storm winds driving 26-ft seas. The ERLANGEN, headed east, was fighting 55-kt winds from the south-southwest on her starboard side. The drilling rig VC8062, off Nova Scotia, was being badgered by 50-kt winds and 28-ft seas. The 23°F air temperature did not make life very pleasant. This made a good potential for moderate to severe icing. Ocean Station Vessel "B" had freezing 50-kt northerly winds and moderate snow. On the 1200 chart, many ships were reporting gale winds, but there were no reports within 300 mi of the center, except "B." The AMERICAN ACE was at 48.3°N, 30.4°W, 700 mi southeast of the center, with 50-kt winds, 25-ft seas, and 33-ft swells. On the 10th, the BESSTRASHNIJ was headed westward toward Newfoundland and whipped by 60-kt winds. The JOHN CABOT, northeast of Trinity Bay, shivered in 45-kt gales.

On the 10th, a satellite LOW developed in the southeast quadrant and moved northward. On the 11th, the two LOW's straddled the southern tip of Greenland. On the 11th and 12th, the original LOW moved up Greenland's rugged west coast to dissipate in Baffin Bay. The second LOW turned toward the southeast and lost to another even more vicious LOW coming off the continent.

This LOW originated off Cape May early on the 10th and developed rapidly. By 0000 on the 11th, the central pressure had dropped to 974 mb near 43°N, 58°W. The drilling rig VGBZ, midway between the center and the Nova Scotia coast, had a 55-kt blizzard out of the northeast. Further west off Cape Cod, the USCGC EAGLE battled 50-kt gales. Among others, Ocean Station Vessel "H" measured 40-kt winds, as did the CHARLOTTE LYKES, 900 mi to the east.

Twelve hours later, at 1200 on the 11th, the 956-mb storm was a swirling maelstrom. The report of the CRYOS, southeast of Sydney, Nova Scotia, was a roaring 80 kt, with a thunderstorm. This would appear questionable, due to the low seas reported, but, about 70 mi to the south, another ship plot indicated devastating 75-kt winds, including 36-ft seas. On the southeast side of the LOW, about 250 mi from the center, the AMERICAN ACE was whipped by 55-kt winds on her portside, with 26-ft seas and 30-ft swells. Six hours later, the winds had increased to 75 kt and the sea and swell to 28 and 39 ft. Winds of 35 to 50 kt were blowing from the coast of Maine to about 40°W and south to 35°N. The SEALAND MCLEAN was fighting 65-kt winds at 40.5°N, 60°W.

The situation had not improved much by 0000 on the 12th, as the storm tracked northward and was about 120 mi east of St. John's. The AMERICAN ACE, at 44.5°N, 48.7°W, was headed into 55-kt storm winds at 10 kt. The seas were 38 ft and the swells, 41 ft. The ANCO NORNESS reported a thunderstorm and 55-kt winds near 42.5°N, 46°W, about 150 mi south of the ACE. The EDE SOTTORF, MANCHESTER CHALLENGE, and the TATIANA all reported 50-kt winds in various quadrants of the storm.

On the 12th and 13th, the 948-mb LOW circled north of Newfoundland. Its circulation dominated the North Atlantic north of 30°N to 65°N and eastward to 20°W. Ocean Station Vessel "B" was riding out 50-kt winds and 33-ft seas. Four other ships reported 50-kt winds in the southwest corner. There were gale-force wind reports from Kap Farvel south to 35°N, and to 25°W. They were made by the following ships: ACAVUS, ADOLF LEONHARDT, BESSTRASHNIJ, CAROLA REITH, C.P. TRADER, DAWSON, EDE SOTTORF, EVELYN BOLTEN, JOHN A. MACDONALD, MANCHESTER CHALLENGE, MEERKATZE H, SEDCO I, SIDIMI, TAUPO, WARRIOR, WALTER HERWIG, and VGBZ.

The LOW was now in the process of filling as it stalled over Newfoundland. Several small LOW's had formed on its edges, and the gradient was a lot weaker. A newcomer to the scene reported 50-kt winds south of Newfoundland at 1200 on the 13th. By the 15th, the LOW had deteriorated to a trough out of the LOW's that had moved around the edge and were south of Iceland.

High pressure over eastern North America, behind the LOW described above, had pushed the associated front south to parallel the Gulf Coast. During the preceding 24 hr, several waves formed on the front. On the 13th, another wave was analyzed southeast of Cape Hatteras. About 30 mi east of Cape Hatteras, the CARBIDE TEXAS CITY reported 35-kt gales. The LOW rapidly moved northeastward, developing and expanding its circulation as it went. About 0700, the center passed nearly directly over the ESSO FLORENCE, and, at 1200, she was moving against 40-kt gales. The LASH ESPANA, about 120 mi to the west, reported 45-kt winds.

The LOW was under the upper-air maximum wind band, which was over 130 kt at 500 mb, racing northeastward at 50 kt. By 1200 on the 14th, it was near 46°N, 42°W. The ATLANTIC CHAMPAGNE was ramming into 50-kt bow winds and 20-ft seas south of the center. North of the center, the DART ATLANTIC had 40-kt winds on her stern. Four hundred miles to the south, ahead of the cold front, the C.V. STAGHOUND was on the trail of 45-kt gales.

By midday on the 15th, the storm was northwest of Ireland and had passed south of a smaller system, which was ahead of it and south of Iceland. Three ships reported 45-kt winds; they were the EUROFREIGHTER, Ocean Station Vessel "J," and a ship that could not be identified.

This LOW plus another following close behind fed energy into the semipermanent Icelandic Low, which now started to deepen and became the predominant

feature on the 17th, as this LOW was absorbed in the overall circulation. On the 16th and 17th, the ATLANTIC CAUSEWAY, FALSTRIA, and the MARIA L. BOLTEN battled 50-kt winds. The ATLANTIC CAUSEWAY also reported 39-ft swells. About this time, the C. P. VOYAGEUR, London for Quebec, had containers damaged and winch controls washed off the forecastle. At 0000 on the 18th, the central pressure was 962 mb. The NORSE VIKING, near 52.5°N, 35°W, wallowed in 50-kt crosswinds and 33-ft swells.

The BRUNSWICK was caught by 60-kt winds and 30-ft swells on her bow, near 49.4°N, 20.7°W, just east of a trough line, at 1200 on the 18th. On the 19th, the LOW started weakening and moving eastward. Its demise was rapid as it disappeared from the charts on the 20th.

This storm was a combination of two LOWs. One had tracked across the Northern Plains States and the other had formed only a few hours before over Maryland. They combined at 0000 on the 17th over the Hudson River. By 1200, the pressure had dropped to 974 mb. The EVELYN BOLTEN, near 36.5°N, 68°W, was engulfed with 50-kt winds and 16-ft waves. The STAGHOUND, at 40.8°N, 63.5°W, also encountered the same winds and seas. Gale-force winds extended from Newfoundland to 30°N.

The winds in this storm system were not as high as some others this month, but they were widespread. On the 18th, two ships reported 50-kt winds. They were FERNFIELD at 36.6°N, 61°W, and the MOBIL AERO at 39.8°N, 72.1°W. The CALLAGAN had 45-kt gales and 20-ft waves. The storm center moved across the Labrador Coast, north of Goose Bay on the 19th. Gales were still blowing as far south as 35°N, south of Nova Scotia. The LOW continued northward into the Davis Strait, and on the 20th curved back southeastward to disappear from the weather charts on the 22d.

This was a short-lived storm. An area of low pressure between two high-pressure areas developed into a LOW on the 21st, over the western slopes of the Appalachian Mountains. The LOW moved east and northeastward to east of Portland, Maine, at 0000 on the 22d. At that time, the pressure was 985 mb, and five ships reported 35-kt gale-force winds. The MELVIN H. BAKER battled 55-kt winds at 0600, near 43.9°N, 64.3°W, with thunderstorms and 200-yd visibility. Twelve hours later, it was over Anticosti Island, a small but tightly wound storm.

The LOUIS S. ST. LAURENT, in the Strait of Belle Isle, was battered by 60-kt winds out of the southeast. A few miles away, the N. B. MCLEAN had 40-kt gales. The BRUNSWICK and POSEIDON, south and east of St. John's, also found 40-kt gales. As the storm moved northeastward, its center passed over Ocean Station Vessel "B," which reported 49-kt gales after passage. There were no other ship reports in the area. About 1200 on the 24th, the LOW crashed against Kap Farvel and almost split into two centers, but it slid off to the right and moved up the east coast of Greenland. As it passed west of Ocean Station Vessel "A," it treated her to 40-kt winds and snow showers. West of Iceland and still over the Greenland coast, the storm was dissolved by the 26th.

An arctic front extended southwestward out of a LOW in Quebec. It was on the front side of the upper-air trough on the 24th, and waves were forming and moving northeastward along the front. The polar front was further south over the Gulf of Mexico and across northern Florida to a wave off Cape Hatteras. The polar wave moved northeastward off the coast as the arctic front pushed southeastward. By 0000 on the 25th, there were two LOW's; one at 990 mb over southwestern Labrador and the other at 996 mb over Cape Breton Island. At this time, the gale-force winds were associated with the maritime LOW. The ATLANTIC CROWN, ATLANTICA MONTREAL, EXPORT AGENT, and VGBZ all were involved with 40-kt winds.

By 1200, the two LOW's had combined into the northern one, whose pressure had dropped to 975 mb. Ocean Station Vessel "B" now had 40-kt winds. The CRYOS, near 44.5°N, 50.5°W, was reporting 55-kt winds, as the AFOUNDRIA, near 40°N, 55°W, radioed 40-kt gales.

The LOW was still deepening as it moved northward up the Labrador Sea. At 0000 on the 26th, Resolution Island was plotted as being ravaged by 80-kt winds. Ocean Station Vessel "B" had 45 kt and 16-ft seas, while just to the south, another ship reported 40 kt. The LOUIS S. ST. LAURENT, near Corner Brook, Newfoundland, was hounded by 45-kt winds. Twelve hours later, Ocean Station Vessel "B" was still fighting 40-kt gales, but now the temperature had plunged to 16°F, the seas were 18 ft, and they reported 0.4 in of ice from spray, and slowly building. It was not the only ship with icing problems. The POSEIDON, about 200 mi east of Belle Isle, reported 0.8 in of ice from spray, but not increasing. There were no further reports plotted from Resolution Island, but, 12 hr later, Frobisher reported 30-kt from the northwest. At 0000 on the 27th, "B" again had 45-kt gales and 16-ft seas, but no report on ice. The temperature was still down to 21°F. As the front passed, Ocean Station Vessel "A" reported 35-kt winds and 15-ft seas, with 10-ft swells.

As the LOW reached Frobisher Bay, it stalled and started to fill. Later, it moved toward the northwest and over Foxe Basin.

As a high-pressure area moved across the eastern United States, it fed warm, moist air into the midwest and plains States. A frontal system developed over the northern plains between the warm, moist air from the south and the cold, dry air from the north. A LOW formed on the front on the 25th. The LOW moved eastward behind the HIGH, developing rather slowly. At 1200 on the 27th, it was 990 mb over Nova Scotia. At that time, the GAUSS, near 39°N, 58°W, and the ST. MARGARET, near 41.5°N, 66°W, both reported 40-kt gales. To the north, just off Cape Sable, the VIGILANT was battling 28-ft seas and swells.

Twelve hours later, as the LOW moved over water, the central pressure continued to drop to 978 mb, and the wind speeds increased. The highest winds were measured by three drilling rigs--SEDCO I, 60 kt; VC8062, 60 kt, with 33-ft seas and 1.2 in of ice from spray increasing slowly; and VGBZ, 55 kt and 25-ft seas. Due south of the LOW, which was over Argentia, the ABIDA was plowing into 45-kt gales. Gale-force winds were reported up to 600 mi out in the southern quadrants.

The LOW was moving slowly northeastward as its pressure continued to drop and the area of high winds increased. At 1200 on the 28th, the DLPL, at 45.7°N, 52.3°W, struggled with 55-kt winds. The ABIDA, SULAPHAT, and VC8062 all had 50-kt winds. The VC8062 was still reporting 28-ft seas, and the ice had built to 1/6 in thickness. The CARMEN, at 42.3°N, 56.4°W, suffered 55-kt winds and 26-ft seas. At 0000 on the 29th, SEDCO I was again hit by 60-kt winds.

The circulation from the LOW now covered most of the Atlantic from shore to shore north of 40°N. At 0000 on the 29th, the lowest pressure of 960 mb was analyzed. SULAPHAT was still fighting the high winds as she moved westward. The AMERICAN LEGACY was now added to the 50-kt club, near 52.5°N, 32°W. Ocean Station Vessel "A" was fighting 55-kt freezing winds and 30-ft seas. Ocean Station Vessel "B" had 40-kt winds for over 24 hr.

On the 30th, the LOW had curved toward the east and was filling, but it still was able to deliver 50-kt winds to the SEALAND MARKET. On the 31st, it again turned northward and, by the 1st, was centered near Ocean Station Vessel "A," where it remained until it blended into another system.

Casualties--The 12,700-ton Liberian-registered YOSEMITE broke adrift in a strong current in the Savannah River on the 6th and ran aground. The attempt to rescue the 6,858-ton British oil-well maintenance vessel OREGIS, which had run aground on rocks in the Tyne River during a storm, were abandoned. It was determined the ship had broken her back. A Russian fishing vessel, the MORSHANSK (684 tons), sank after a collision with the Greek NATAL (8,849 tons) in fog off Texel Lighthouse, Netherlands. A LOW that moved up the U.S. east coast on the 17th must have generated the winds that caused the German LINDO to strike the tug HELEN MCALLISTER about 10 mi south of Fire Island. The tug received a gash amidships and listed 15° to port.

The 3,332-ton British motorvessel GINA MARIA arrived Veracruz on the 19th from Antwerp with a damaged starboard due to heavy seas, which pushed in 80 ft of gunwale.

The Navy destroyer DAHLGREN collided with the 40,695-ton Italian tanker EGERIA in fog off the Hampton Roads bridge and tunnel. There were no injuries. The 381-ton Dutch motorvessel SPRAY was caught in ice about 250 mi southwest of St. John's, Newfoundland. Shell plating was damaged, but she was not taking water as she drifted southward in northerly gales. The vessel was unable to use its propeller in the ice and requested assistance.

The Cypriot VERZA (2,002 tons) ran aground in dense fog near Brehat Island in the English Channel and sank on the 27th. The crew was rescued. The 10,427-ton French ANGO at anchor and the 44,001-ton Liberian ore carrier NIMBA were in collision in dense fog, on the 29th, off the Netherlands.

SMOOTH LOG, APRIL 1974--Storm tracks across the eastern United States were near normal for location to slightly above normal in number. Fewer than normal came out of central Canada to the junction over the Great Lakes, and the track was more northerly than the mean up the St. Lawrence River valley. The LOWs originating and moving up the East Coast were normal, with a more northerly component.

The majority of the LOWs tracked over or near Newfoundland and then northeasterly to the southern tip of Greenland and the Denmark Strait. Only one LOW that originated west of 25°W moved east of Iceland intact, and that was after May 1.

Several storms tracked across the Mediterranean Sea, but none were indicated to be severe. There was one ship report for 35-kt winds south of Sicilia.

The pressure pattern west of 30°W was normal in pattern and near normal in pressures. The 1003-mb Icelandic Low was located near its 1007.5-mb climatological position, slightly southeast of Kap Farvel. A major trough extended southwestward over Newfoundland. The Azores High, at 1025 mb, located near 30°N, 46°W, was about 5° west of its climatological 1021-mb position. A 1024-mb High was centered over the Shetland Islands and connected with the Azores High by a saddle or col area. Normally, a tongue of low pressure from the Icelandic Low dominates this area of the Norwegian Sea. The Mediterranean Sea experienced generally lower pressure than normal, with several small Highs and Lows. The predominant feature was a 1010-mb Low centered near Liverno.

The major anomaly was a plus 13 mb centered near the Faeroe Islands. The Azores High produced a plus 4 mb near its center. The negative anomalies were a 9 mb over Ellesmere Island, a 4 mb southeast of Kap Farvel, and a 5 mb over the Ligurian Sea.

The upper-air pattern at 700 mb indicated zonal flow across the eastern United States to 30°W, between 30°N and 50°N. The Low was many miles northwest of the surface Low, over the north magnetic pole near Bathurst Island. A trough stretched southeastward over Baffin Island and the Labrador Sea. The two Highs were stacked nearly vertical with their surface counterparts.

There were no tropical cyclones, and none are expected this early in the year.

This first storm of the month formed over Cape May. It moved northeastward south of Nova Scotia, gradually intensifying. At 0000 on the 4th, the 994-mb LOW was near 43.5°N, 47.5°W. The STEPHANITOR was about 180 mi to the south and found 40-kt gales. Twelve hours later at 1200, the rapidly deepening LOW slowed and turned more northward. The center passed within 60 mi of the ULTRAMAR and hit her with 55-kt winds and 20-ft seas from the southwest on her westerly heading. The C. P. DISCOVERER passed just north of the center with rapidly shifting winds. At this time, she was fighting 45-kt northerly winds, 16-ft seas, and 23-ft swells. To the south, near 39°N, 41°W, the BEL HUDSON was sailing with 40-kt winds on her stern.

At 0000 on the 5th, the storm continued to harass shipping. The KHIBINSKIE GORY's weather plot was not clear, but appeared to be 55-kt winds. Gale-force winds were reported as far as 700 mi to the southwest.

The pressure gradient was relaxing on the eastern side of the storm, as it was slowly filling, but remained tight on the western side, at 1200 on the 5th. The TROLL PARK was not aware of this, near 46.8°N, 39.1°W, as she fought 55-kt portside winds with 20-ft

swells. Nearby, the ATLANTIC CHAMPAGNE estimated only 40-kt gales, but the seas were running 23 ft. The MUENCHEN, near 43°N, 38°W, or about 300 mi south-southwest of the center, was fighting 45-kt gales, 13-ft seas, and 30-ft swells. Nine hundred miles south of the center, the BREITENSTEIN found a 45-kt isotach.

For the next 48 hr, the LOW drifted slowly northward and almost died out. On the 8th, a new system approached from the southwest, and the point of occlusion of the front moved into the LOW and rejuvenated it.

It was this storm system that combined with and renewed the one above. It formed almost over Cape Hatteras at 0000 on the 6th and moved up the East Coast. The Bermuda High was well entrenched east of Bermuda and blocked easterly movement. As the storm approached Nova Scotia, VGBZ was hit by 45-kt gales. Ocean Station Vessel "H" measured 43-kt gales with 18-ft seas, at 0000, and the MARCONA TRANSPORTER, less than 30 mi away, found 41-kt winds and 10-ft seas.

By the time the LOW moved into the Strait of Belle Isle on the 7th, the pressure had dropped to 976 mb. Two ships reported 45-kt gales ahead of the cold front. One was the CETRA COLUMBA.

On the 8th, as the LOW moved up the Labrador Sea, the reports from Ocean Station Vessel "B" were sorely missed, as there were no reports from the 3d until the 15th, when the USCGC CHASE appears to have replaced the DUANE.

It was on the 1200 chart that the occlusion moved into the previous LOW. This resulted in a LOW on each side of Kap Farvel. A 1042-mb HIGH was centered over the northern ice cap. The combined circulation of the two LOWs and the HIGH produced 65-kt hurricane-force winds for Kap Farvel. Narssarssuaq had 45-kt downslope winds from the east-northeast.

The eastern LOW moved up the Denmark Strait and disappeared on the 10th, while the western LOW passed over Resolution Island and dissipated on the 11th.

This storm was manufactured on the Midwest assembly line on the 7th. At 1200 on the 9th, it was over the Chesapeake Bay. It turned northeastward and treated Ocean Station Vessel "H" to 50-kt winds and 21-ft waves. The EXXON NEW ORLEANS at 34.9°N, 74.2°W reported 45-kt gales, 6 hr later. At 1200 on the 10th, the HUDSON was in the Strait of Belle Isle with 35-kt easterly winds. It was snowing heavily, and she reported 9 cm of ice from spray, building rapidly. Ships in the southern quadrant, with 35-kt gales, were having a picnic in comparison. At 1200 on the 11th, the LOW split into two centers, as it passed west of Newfoundland. The drilling rig VGBZ was regaled by 40-kt winds.

At 1200 on the 12th, the LOW split again, as it drove against the ice wedge of southern Greenland. One LOW stalled at Kap Farvel, while the other disappeared into the Denmark Strait.

The middle of the month was relatively quiet, with no storm producing reports more severe than 60 kt.

One of these was a short-lived storm that developed on a front just north of the Azores Islands on the 15th. A day earlier, a LOW had raced northward up the same front, as this one was destined to do.

At 1200 on the 15th, the HANNOVER, on the west side of the LOW, and the MINERAL OUGREE, on the east side, were both hit by 45-kt gales. At 1800, the ULTRAMAR was headed southeastward into southeasterly 58-kt storm winds churning 41-ft seas, near 46.7°N, 23.9°W. At 0000 on the 16th, she still reported 57-kt winds with 30-ft seas and 33-ft swells. At 1200, the AMERICAN LEGACY, near 48.2°N, 27.6°W fought 45-kt winds with 13-ft seas and 25-ft swells that were moving 30° to the seas. As the storm moved northward, the MARQUIS and the VORWAERTS reported 35-kt gales. Prior to dissipating on the 17th, it treated another ship to 40-kt gales.

This one was born in the Texas-Oklahoma Panhandle on the 13th, and the center moved across Lakes Michigan and Huron on the 14th. It was an intense storm -- 992 mb -- with many land stations reporting prevailing 30-kt winds. The orientation of the LOW and the winds caused flooding on eastern Lake Erie. Warnings were issued for flooding and beach erosion from Cleveland to Buffalo, as winds gusted to 44 kt. A Canadian station on the north shore of Lake Ontario reported 35-kt prevailing winds at 0600 on the 15th. The MELODIC (39,617 tons) grounded off Port Cartier after dragging her anchor in the high winds. By late that day, the winds decreased as the LOW moved up the St. Lawrence River valley.

It crossed the Labrador coast near Mary's Harbour early on the 17th. It had already bestowed 35-kt gales on ships off the coast, while still inland. At 1200 on the 17th, Ocean Station Vessel "B" reported 40-kt gales. As the 982-mb LOW moved eastward across Belle Isle, the DNEPRODZERZHINSK, the FINNAMORE MEADOW, and the IVAN AIVAZOVSKY were treated to 40- and 45-kt gales on the 18th. As the storm moved northward toward Kap Farvel, it weakened and stalled in the Labrador Sea, where it slowly circled until the 22d. At that time, it turned sharply eastward and dissipated on the 23d.

An area of very flat gradient existed off the U. S. east coast and southeast early on the 20th. Between 0600 and 1200, a cyclonic circulation developed east of Norfolk. At 0000 on the 21st, the 1005-mb LOW was at 36°N, 58°W. The DAWSON was near 36.5°N, 63.5°W, with 45-kt gales. Earlier, about 1600 on the 20th, the LOW and the DAWSON had crossed paths. The MARQUIS was north of the center, with 35-kt gales and 20ft swells.

On the 22d, the LOW was headed northeastward, and the EDE SOTTORF found 45-kt winds in the southwest quadrant. The USCGC EVERGREEN, north of center near 46°N, 44.5°W, had 40-kt gales. The MAUMEE outshone them all, at 0600 near 42°N, 47.6°W, when she joined the battle against 55-kt storm winds out of the northwest with 10-ft seas and 20-ft swells from the north.

By 1200 on the 22d, the 984-mb LOW had traveled to 47.5°N, 40.5°W. The AMERICAN ACE, BIOKOVO, BIRKENSTEIN, and the CAST BEAVER surrounded the LOW and radioed 40- to 45-kt gales. This LOW originated further east and passed east of Kap Farvel, but still foundered on the rocks and ice of Greenland's east coast.

This storm, which raised havoc over the Great Lakes, can be traced back to Nevada on the 18th. The LOW moved eastward and, on the 20th, turned northeastward as it pushed against a HIGH over the northeastern United States. Gale warnings were posted for Lakes Michigan and Superior late on the 21st, as the storm approached. The central pressure was about 990 mb as the LOW passed over Lake Superior on the 22d.

As the storm moved eastward across Ontario, strong northerly winds replaced the earlier southerly gales. On the 23d, gale-force winds were blowing across Lake Superior and down Lake Michigan. Waves caused more beach erosion along the eastern shore of Lake Michigan. As the storm continued eastward, gale warnings were posted for Lake Huron on the 24th. Gusty 30- to 35-kt winds were blowing over the lower lakes.

On the 23d, the LOW split into two centers, the new one forming over New Hampshire, while the main LOW continued eastward over Newfoundland. This weakened the gradient, and no gale-force winds were reported by shipping until the 25th. The highest wind reported at sea during this storm was 40 kt, by Ocean Station Vessel "I" at 0000 on the 26th. At that time, the LOW was moving northward into the Denmark Strait, where it dissipated on the 27th.

This last storm of the month developed over Ontario on the 29th, but did not cause any grief until May. As it moved over Newfoundland at 1200 on the 30th, it was a weak 1000-mb circulation. As it moved over the warmer water, it started growing. At 1200 on May 1, the JOHANN BLUMENTHAL, near 47.5°N, 33.5°W, was hit by 45-kt gales as she passed about 240 mi south of the center.

On the 2d, the LOW approached the Bay of Biscay, where its eastward movement slowed considerably. The NIENBURG, near 46°N, 19°W, was whipped by 50-kt winds. Further north near 49°N, the ROCKENHEIM was swept by 45-kt winds, as was the ZEEBRUGGE at 44.2°N, 15.1°W. Waves of 15 to 20 ft prevailed over the area. At 0000 on the 3d, 40- to 45-kt winds were blowing, and the waves had built to 25 and 30 ft. At 1200, the CITY OF WORCHESTER, near 46°N, 10°W, was hammered by 50-kt winds and 23-ft seas. A ship reported 33-ft swells off Cabo Finisterre.

On the 4th, the LOW split into three centers. The center that formed over southern Germany became the dominant circulation and moved inland.

Casualties--The 9,171-ton Canadian Laker POINTE NOIRE became stuck in ice on Lake Superior near Blake Point, Isle Royale, on the 4th. On the 8th, arrangements were made to rescue the crew of the British motorvessel MERCURY, aground near Punta Beata, Dominican Republic, by helicopter, because the crew was in danger due to weather conditions. The British trawler HULL CITY (711 tons) and the Bulgarian trawling factory ship FREGATA (3,152 tons) collided in fog, near 58.9°N, 01.1°W, on the 8th. The American EXPORT AGENT (7,849 tons) struck a shore crane at Isbenderum, Turkey, due to a heavy storm on the 29th. On the 25th, the cruise ship ROTTERDAM (37,783 tons) was grounded in a heavy gale in the Bermuda Narrows.

Smooth Log, North Pacific Weather

March and April 1974

SMOOTH LOG, MARCH 1974--There was an abundance of extratropical storms this month. The primary tracks out of Asia were normal, but the track across the water was much further south, rather than along the Aleutian Islands and into the northern Gulf of Alaska. The primary west-to-east track was between 35° and 45°N in the western ocean and between 40° and 50°N in the eastern ocean. There was also a secondary track which branched off northward into the Bering Sea.

The mean pressure centers were displaced southeastward. The 1005.3-mb Aleutian Low, which is located near 52°N, 167°E, according to climatology, was 995 mb near 47°N, 178°W. The Pacific High was about 1 mb lower than normal, at 1021 mb, and centered near 25°N, 130°W, or about 1,000 mi southeast of its climatic location.

The major displacements resulted in a large negative anomaly center of 17 mb near 42°N, 173°W. A negative 8-mb subcenter was located off the Queen Charlotte Islands. A positive 5-mb anomaly center was located west of Cabo Falso near 23°N, 120°W.

There was one tropical storm--Amy--in the western North Pacific and none in the eastern North Pacific.

The first week of this month, the North Pacific was cut up by many relatively small pressure centers. The only large pressure feature was the eastern North Pacific High, which was centered between Hawaii and Seattle. On the 4th, a small LOW formed in a trough off Yakatat, Alaska. The gradient tightened rapidly. At 1200, the GALVESTON at 57.3°N, 145.1°W encountered 60-kt minus 3.4°C winds and swell waves of 30 ft. The EXXON NEWARK was running into 50-kt winds and 33-ft swells at 0000 on the 5th. The swells increased to 39 ft at 1200. At 0600, the GALVESTON, further north at 57.6°N, 146.4°W, still fought 60-kt winds and 30-ft waves. By 0000 on the 6th, the LOW had dissipated back to a trough again. This did not help the EXXON NEWARK, at 1200, which was still sailing into 50-kt winds and 36-ft waves.

At 1200 on the 7th, another LOW formed in the semipermanent trough, south of Montague Island. This LOW remained quasi-stationary and deepened as several transient LOWs moved around the southern circumference. At 1200 on the 8th, the J.H. TUTTLE had 45-kt winds off her bow, south of Kodiak Island. Twelve hours later, the USCGC's WINONA and YOCONA reported 55- and 50-kt winds just south of Cape Flattery. At 0600 on the 9th, the SUMMIT, at 54.5°N,

152.4°W, was tossed by 41-ft waves and 65-kt winds. The minor LOWs had been moving eastward south of the center and crashing into the Alaska-British Columbia Coast, about one per day. The LOW gradually drifted southward and, at 1200 on the 10th, was near 50°N, 139°W. At that time, the SUMMIT was near 55.5°N, 157.5°W, and was hit by 60-kt northerly winds. On the other side of the LOW, the Portland Lightvessel had 40-kt southerly winds. The LOW gradually drifted eastward and was filling, and there were isolated reports of gale-force winds. On the 13th, the LOW had two centers; the new one was just south of the Kenai Peninsula. By the 14th, the LOW had disappeared.

This was part of a train of LOWs that were developing near Japan and running east toward the southern Gulf of Alaska. This 1003-mb LOW formed further east, near 35°N, 163°E, late on the 8th. The LOW just ahead of it had generated 50-kt winds for the GREISHAM (44.5°N, 174°E) and the KEIKO MARU (53.5°N, 178°W).

In the next 24 hr, the LOW traveled northeastward and intensified with gale-force winds. At 0000 on the 10th, it brought 45-kt winds to the BREMEN MARU and the TOKUSHO MARU, south and west of the center, respectively.

At 1200 on the 10th, the Russian vessel PRIBOI, near 41°N, 175°E, measured 60-kt storm winds from the north, with heavy rain, while 12 hr earlier she had been basking in 10-kt southeasterly winds at a more northerly position. At 1800, the WYOMING, at 35.9°N and the Date Line, was moving westward into only 45-kt winds but the swells were 49 ft. At 0000 on the 11th, the DAISHIN MARU also found 60-kt winds about 60 mi northwest of where the PRIBOI reported them. The system now had a double center, as a secondary LOW formed near the triple point. The two LOWs again combined into one, with a pressure of 973 mb. At 0600, the WYOMING was still recording 49-ft waves. The ONXE found 50-kt winds near 48°N, 179.5°E, with 20-ft seas.

The LOW had been pushing against a high-pressure ridge which extended southward over the Bering Sea. The high pressure was building southward and forced the LOW on a southeasterly track. The central pressure of the LOW was rising even though its area of cyclonic circulation expanded all the way to the U.S. west coast. Only minimal gales were being reported.

On the 14th, the 988-mb LOW turned northeastward again as it moved closer to the coast. It moved over the Queen Charlotte Islands late on the 16th and dissipated.

Earlier, a LOW had moved out of the Sea of Japan into the Sea of Okhotsk and straddled the Kamchatka Peninsula. A trough from this system extended southward off the east coast of Japan. The southern part was very weak, and, on the 11th, a LOW formed in the bottom of the trough. By 1200 on the 13th, the 984-mb LOW was at 43°N, 165°E. The PRIBOI, near 45°N, 170°E, measured 40-kt winds northeast of the center. Gale winds were found as far as 850 mi to the southwest and 750 mi to the south. The DAISHIN MARU reported thunderstorm activity. Twelve hours later, the DAIAN MARU had 50-kt gales, as the storm center passed just east to north of her position. That was only the beginning. Twelve hours later, at 1200 on the 14th, she was hit by 60-kt winds, as the ship moved northeastward and the storm northward. The seas were 16 ft and the swells, 30 ft. North of the center, the KATHRYN MARU was rocked by 50-kt winds. At 0000 on the 15th, another ship was hit by 50-kt winds within a few miles of the center.

Late on the 15th, another LOW center developed on the occlusion and moved to a position east of the old center. This relaxed the gradient, as the circulation stretched east-west. Gale-force 35- to 40-kt winds were spotted around the circulation. As is the usual case when a subcenter develops, the pressure started to increase. The path of the center traced a loop east of Kamchatka and was absorbed by another weather system on the 17th.

Monster of the Month.--This small LOW was first picked up on the 18th, just southeast of Tokyo. Tropical storm Amy was about 800 mi to the south and moving east-northeastward. As Amy weakened and dissipated, this LOW developed. By 1200 on the 20th, the 978-mb extratropical LOW had absorbed all traces of the tropical LOW, except a ship report of high seas. About 250 mi southwest of the center (36°N, 162°E), the TOYOTA MARU No. 11 ran into 45-kt gales. North and east of the center, the KAKO MARU and the BREMEN MARU fought 40-kt gales. On the 21st, the OCEAN BRIDGE, about 700 mi to the southeast near a small transient LOW, was battered by 50-kt southerly winds.

Twelve hours later, the central pressure of the LOW was 964 mb, near 39°N, 178°E. There were no reports within 300 mi of the center, but, to the south and southwest, the LITIJA had 55-kt winds on her starboard side, with 18-ft seas and 20-ft swells. The GOLDEN GATE BRIDGE and another ship reported 50-kt winds and 27-ft seas.

The winds were increasing in speed and area. The MONDO, 350 mi due south of the center, was slowly cruising into 60-kt storm winds with 21-ft seas and 30-ft swells. Southwest of the center, three ships had winds of 50 kt or greater. They were GOLDEN GATE BRIDGE, WARYU MARU, and another ship. The WARYU MARU reported 30-ft seas and swells. The 8,373-ton Cypriot ELNA, Los Angeles for Yokohama, reported encountering severe weather about 1,000 mi northwest of Hawaii. Twelve hours later at 1200 on the 22d, a ship 900 mi south of the center was battered by 50-kt winds and 31-ft seas. The GUAM BEAR, about the same distance to the southeast, also had winds of 50 kt. The ZIM NEW YORK had winds ranging from 55 to 63 kt and seas up to 36 ft on the 21st and 22d. The UNION EXPANSION, at 38°N, 170.3°W, combated 56-kt winds and 41-ft swells with 16-ft seas.

At 0000 on the 23d, three ships reported 60-kt winds and anything but pacific seas. The UNION EXPANSION had 16-ft seas and 41-ft swells, the ZIM NEW YORK had 36-ft seas and 39-ft swells, and the JGFM had 16-ft seas and 30-ft swells. The ESSO BRASILIA, HAWAII BEAR, and the VOLNAY all encountered 50-kt winds, with the BEAR fighting both 49-ft seas and swells. On the 23d, the pressure reached its lowest of 952 mb. There were no reports within 600 mi of the center at 1200, but the JFZG, which was 650 mi southwest of the center, radioed 45-kt winds, 26-ft seas, and 46-ft swells near 32°N, 173°W.

Early on the 24th, the center split into two LOWs, with a third approaching from the west. There was only one report of winds as high as 60-kt, by the MARGARET CORD, near 34°N, 168°W, with 33-ft seas. The maximum wind band was over 400 mi south of the centers, between 27°N and 40°N. The exception was miles east of the system, ahead of the front. Ocean Station Vessel "P" was receiving 45-kt gales, and the TURANDOT, near 46°N, 145°W, had 50-kt winds. Late in the day, at 1800, the RED JACKET, at 37.2°N, 175.9°E, had 65-kt winds and swells of 30 ft.

On the 24th, this was the only major circulation system in the North Pacific. It stretched from Japan to California. There were three small HIGHs in the low latitudes, but they were flat with weak circulations. On the 25th, the three centers combined into one, but another LOW had formed on the western edge. The most severe wind reported on the 25th was 65 kt by the RED JACKET at 37.2°N, 175.5°E. The UNION EXPANSION had 49-kt winds but her worst problem was 16-ft seas and 44-ft swells. Sea and swell reports of 15 to 25 ft were common, with the long fetch and relatively straight flow. Most of the gale reports were between 30° and 40°N.

On the chart of 0000 on the 26th, the area of 50-kt winds had moved eastward. The JAG ANJLI, near 38°N, 161.5°W, had 50-kt winds. For the rest of its existence, there were only isolated reports of strong winds. The LOW's track turned northward on the 25th and westward on the 27th. It continued westward to the vicinity of Adak Island on the 29th, where it was lost on the charts.

During this period, many other LOWs developed and faded, passing through the pressure system, but an effort was made to track the original center. At times, it was not the center of lowest pressure.

The East China Sea is one of the favorite spawning areas for storms in the North Pacific. That is where this one developed on the 24th. At 1200 on the 27th, it was 996 mb near 33.5°N, 146.5°E, when the first gales were reported. The PHILIPPINE MAIL at 36°N, 148°E encountered 55-kt easterly winds with 20-ft seas at 1800. On the 28th, it and the KOREAN MAIL were both fighting 60-kt winds. The PHILIPPINE MAIL was about 200 mi southwest of the center with 20-ft seas and swells, and the KOREAN MAIL was about 250 mi east-northeast of the center with 26-ft swells.

The storm center was moving faster than the ships and passed very close to the KOREAN MAIL on the 28th. At 0000 on the 29th, she reported northwesterly 60-kt winds with 25-ft swells, near 39.4°N, 162.8°E.

On the 29th and 30th shipping appeared to avoid the strong wind area south of the storm as there were no reports radioed or mailed from that area. At 1200 on the 30th, the LOW was 973 mb near 46°N, 172°W. The PRESIDENT HARRISON was near 37°N, 176°W with 35-kt winds. There were no other reports between it and the Aleutian Islands in the area of the storm. At 1200 on the 31st, the IVAN KOTLYAREVSKIY, near 50.5°N, 179.5°W, was hounded by 50-kt winds on her stern.

On the 31st, the storm center was moving northward and weakening. On the 1st it again turned eastward but was no longer a major threat to ships. It moved into the Gulf of Alaska and passed near Ocean Vessel "P" late on the 3d, then turned to a northerly direction. By the 6th, it was too weak to survive the rough Alaskan coast.

Tropical storm Amy, the second western Pacific tropical cyclone of the season, formed some 300 mi south of Guam on the 14th. She remained a tropical depression for the next 3 days. Amy headed west-northwestward, but recurved after passing Yap Island. She became a minimal tropical storm on the 17th, near 15°N, 138°E. At this time, Amy was heading northeastward. Winds of 35 kt, with gusts to 45 kt, blew around her center. On the 19th, as she was in the process of turning extratropical, sustained winds jumped briefly to 45 kt. Amy finished her extratropical transformation later in the day, as she passed close to Marcus Island.

Casualties--A collision in dense fog at Inchon, Korea, on the 8th, damaged the 16,832-ton Taiwanese bulk carrier EVER HONOR and the 3,818-ton South Korean INCHON. More victims of fog were the 980-ton Japanese EISEI MARU and the 4,469-ton Panamanian PANORIENTE which collided off Kobe on the 6th. The 9,501-ton Russian TIKSI sank during a heavy storm off southern Honshu, on the 22d, with heavy loss of life. Fifteen bodies were recovered from the sea.

SMOOTH LOG, APRIL 1974--The North Pacific was near normal this month. The storm tracks followed the climatological pattern very well and were normal in number. There were two primary sources of storms, one across the southern Sea of Okhotsk and the other south of Japan. The tracks joined south of the Near Islands and paralleled the Aleutian Islands into Bristol Bay and the Gulf of Alaska. A secondary track came out of the midocean north of Hawaii and into the Gulf of Alaska.

The mean sea-level pressure pattern was normal, but more intense. The 1009-mb Aleutian Low, which climatologically has several subcenters from Kamchatka to Bristol Bay, had two subcenters--1002 and 1003 mb--but without the subcenter near Kamchatka. The Pacific High also had several centers and was 2 to 4 mb higher in pressure. The eastern center was about 20° longitude further east along 140°W.

The anomaly centers clearly indicated the difference from the climatic mean. The ocean north of 40°N, except from Vancouver Island south along the North America coast, was basically negative. A negative 8-mb center was located south of Umnak Island. A positive 7-mb anomaly was centered near 35°N, 135°W, and positive 3 mb near 30°N, 175°E.

The upper-air pattern was mainly zonal flow around a Low over the Bering Sea, with two trough lines, one over the Asian east coast and the other through the Gulf of Alaska along the West Coast. A ridge extended from the northern Rocky Mountains across Alaska to a High over the East Siberian Sea.

Tropical storm Babe, in the western Pacific, was the only tropical cyclone.

The storms this month were less severe than in the previous winter months, but about the same as last year during April. There was no large LOW that developed and dominated a major part of the ocean,

where exceptionally high winds and seas can be generated.

The first significant LOW came into being in a trough extending out of a LOW in the Gulf of Alaska on the 3d. It was first discovered on the weather charts near 40°N, 164°W, at 0000. It swung southeastward, but, by 0000 on the 4th, it was headed northeastward, at 1006 mb, near 38°N, 150°W. The TOSCA and UNION SUNRISE were both headed westward south of the center. On the backside of the LOW, they encountered 45-kt gales from the northwest. The center continued on a northeasterly track toward Vancouver Island. At 1200, the HIEI MARU measured 52-kt winds at 37.2°N, 147.3°W, and at 1800, the SUMMIT at 58.6°N, 150.2°W found 45-kt winds. At 0000 on the 5th, the PHILIPPINE MAIL, at 36.3°N, 130.6°W, battled 48-kt gales. The PRESIDENT GRANT, 700 mi to the west and 500 mi southwest of the center, bucked 35-kt gales, and the USCGC WINONA, 600 mi to the south, fought 40-kt gales and 18-ft seas.

By 1200 on the 5th, the 977-mb LOW was approaching the West Coast. The WINONA had 30-kt gales off her portside, and the WASHINGTON MAIL, just a few miles away at 37.3°N, 136.6°W, had 35-kt gales, 12-ft seas, and giant 36-ft swells on her bow. Near the coast, the LOW turned northward to pass near the Queen Charlotte Islands on the 6th. The MONT IRON found 45-kt gales about 200 mi south of the center. Land stations on Vancouver and Queen Charlotte Islands reported 35- to 40-kt gales. By the 7th, the LOW had beat itself out on the rugged coast, as other LOWs moved in to replace it.

An elongated north-south trough was situated over the Sea of Okhotsk on the 5th. A weak, diffuse LOW had moved out of Manchuria on the 3d and combined with this trough to intensify it. By 1200, a 998-mb LOW, with a well-developed circulation, was present. The center moved slowly up the Kuril Islands. At 1200 on the 6th, the 982-mb center was near 47°N, 155°E. The weather station on Ostrov Iturup measured 50-kt northwesterly gales.

The surface LOW was located almost directly under an upper-air LOW which was moving around the major long wave pattern as the wave length was making an adjustment. At 0000 on the 7th, the LOW was at 47.5°N, 160°E. South of the center, in a band between approximately 38°N to 45°N, there was an almost straight westerly flow for 1,200 mi. The BEN LOMOND and YONEKAWA MARU were hit by 45-kt gales in this band. The seas were running about 10 ft and the swells up to 23 ft. Northwest of the center, Ostrov Paramushir reported a howling 70-kt wind.

The LOW continued to move eastward at about 25 kt until the 9th, when its upper-air circulation combined with the major upper-air LOW. During this period, only gales of 35 to 40 kt were reported. On the 10th, the surface LOW moved eastward away from its upper-air support and began weakening as it entered the Gulf of Alaska. Just prior to grounding on the Alaska coast near Valdez, it took a last 40-kt swipe at a ship.

Monster of the Month--A weak stationary front lay between the previous LOW and the Pacific High. Near midocean, 36°N, 175°W, a wave formed at 0600 on the 10th. It moved eastward fairly slowly and, at 1200 on the 11th, after passing the THOMAS E. CUFFE, treated her to 35-kt gales. By 0000 on the 12th, the LOW was gaining strength and had a central pressure of 994 mb near 43.5°N, 155°W. The TOYOTA MARU No. 10 was hit by 35-kt gales.

As the storm moved northward into the Gulf of Alaska it continued to strengthen. The WOERMANN SASSANDRA, at 45.5°N, 156.4°W, experienced rain driven by 41-kt gales. At 0000 on the 13th, it was a 972-mb monster near 52°N, 150°W. The ASIA FLAMINGO was in the northwest quadrant near 54°N, 155°W, and was battered by 60-kt winds. Gale winds were blowing all around the center. Some of the reports were from the GOLDEN LIGHT, which reported 26-ft swells, Ocean Station Vessel "P," WORLD PRIDE, and the YONEKAWA MARU. Twenty-four hours later, the WORLD PRIDE still suffered with 45-kt gales, and the WORLD SUPREME fought 40-kt winds. The LOW was now over Kodiak Island and rapidly dissipating. It had completely disappeared by 0000 on the 15th.

This LOW came out of mainland China via the Yellow Sea and Sea of Japan. By 1200 on the 14th, it was moving up the Kuril Islands, a full-blown storm at 984 mb. West of the storm, the ALASKA MARU and the SOYO MARU both found 35-kt gales. At 1200 on the 15th, Ostrov Urup suffered with below-freezing 55-kt winds. The VAN TRIUMPH and WAKAGISAN MARU, in the southern half of the circulation, had 35-kt gales. At 1200, the CHUETSUSAN MARU, 400 mi south of the center, was sailing with 45-kt gales. The LIECHTENSTEIN measured 42-kt gales, about 150 mi southwest of the center, at 1800. At 0000 on the 16th, the VAN TRIUMPH, further away in the southwest quadrant measured 41 kt on her anemometer. The LIECHTENSTEIN was reporting 15-ft seas and 20-ft swells. About 0300 on the 16th, the center crossed the Aleutian Islands near the Near Islands and into the Bering Sea at about 980 mb.

At 0000 on the 17th, the LOW was near 55.5°N, 171°W, and the SOVETSKOE ZAPOLYARYE was cruising into cold 40-kt gales, with snow. Early on the 18th, the LOW moved inland over Alaska at Kuskokwim Bay.

Cyclogenesis occurred between two HIGHs over the Sea of Japan on the 18th. The fledgling moved across Hokkaido and, by 1200 on the 19th, was a 994-mb storm. On the 20th, the SHIN HONSHU MARU was hit by 40-kt gales. At 0000, 24 hr later, on the 21st, the storm was 984 mb and had a wide area of circulation. Forty- to 45-kt winds were blowing all around the center, reported by the CANADA MARU, ELIZABETH LYKES, HANETIA, KETCHIKAN MARU, and the VERRAZANO MARU.

As the storm moved south of the Aleutian Islands late on the 21st, a second center formed north of the islands. On the 22d, the MARUSUMI MARU was sailing with 40-kt gales, about 600 mi south of the center. The PRESIDENT PIERCE, just to the north near 41.4°N, 168.2°E, measured 45-kt northwesterlies, with 18-ft seas. The new center started taking over as the major system and was the dominant storm by the 23d, as it moved into the Bering Strait on the 24th.

A tehuantepecer occurred on the 25th. As is usual in these instances a cold front moved southward into the Gulf of Mexico and a large HIGH over the United States fed cold air into the Bay of Campeche. At 1200 on the 25th, the WALTER RICE was rolled by 45-kt winds on her starboard side near 15.2°N, 93.8°W. Six hours later, the northerly winds had increased to 50 kt at 15.9°N, 95.2°W.

This last storm of the month was relatively short-lived and traveled only a short distance. It formed early on the 28th, off the U. S. Pacific Coast near 45°N, 149°W. As it moved northeastward, it passed almost directly over Ocean Station Vessel "P" at 1800 on the 28th. Another small LOW was following close behind. On the 29th, the isobars appeared to ground on the southern Alaska coast, and the center stalled near 54.5°N, 147°W. The J. H. TUTTLE, at 55°N, 150°W, found 35-kt winds. By 0000 on the 30th, the two LOWs combined into a 992-mb center, and PAPA's wind increased to 35 kt. Twelve hours later, they further increased to 50 kt. The winds continued to blow and were still 40 kt on May 1 for Ocean Station Vessel "P" and the YONEKAWA MARU, as the storm turned southeastward. On the 2d, it moved into the Strait of Juan de Fuca.

Tropical storm Babe was tracked for several days as a tropical wave from the Caroline Islands in late April. It took another few days to intensify from a tropical depression to a tropical storm, which she did about 300 mi north of Guam on the 29th. By this time, however, it was apparent that Babe was in the process of recurving. Her peak intensity occurred on the 30th, when maximum sustained winds near her center reached 55 kt and gales extended out some 125 mi in all directions. By late the following day, the weakening, accelerating storm had turned extra-tropical as she crossed the 30th parallel near 152°E.

Casualties--The 12,593-ton GLYFADA SUMMER arrived Kawasaki about the 7th, with heavy weather damage. The SACRAMENTO VENTURE (11,151 tons) and the WYANDOT collided in heavy seas off Keelung on the 7th. The 8,433-ton Liberian steamer VALL SUN dragged anchor in Pusan Harbor and drifted into a collision with the 2,766-ton Panamanian NORTHERN STAR and a wharf, on the 4th.

A 284-ton tuna fishing boat, No. 11 SHOEI MARU, overturned and sank after a collision with the 11,144-ton OCEAN SOVEREIGN. Fourteen crewmen were feared trapped in the overturned boat, which sank before rescuers, who were hampered by high waves, could reach them. The 4,872-ton Chinese JIAN SHE grounded in Naruto Strait on the 14th. On the 21st, the hull broke in two during heavy weather and sank.

The Korean tanker KOREA HOPE (12,644 tons) grounded in fog near Hong Kong on the 22d. The 2,594-ton Japanese YOSHU MARU No. 8 loaded with cement capsized and sank 1 mi off Imabari on the 25th. Vessel reportedly was sucked into the vortex of a current and developed a list. One crew member died and six were missing. The Cypriot KATINA M. (10,339 tons) and the Japanese TENSEI MARU (2,998 tons) collided in fog, on the 26th, in Kurushima Strait.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

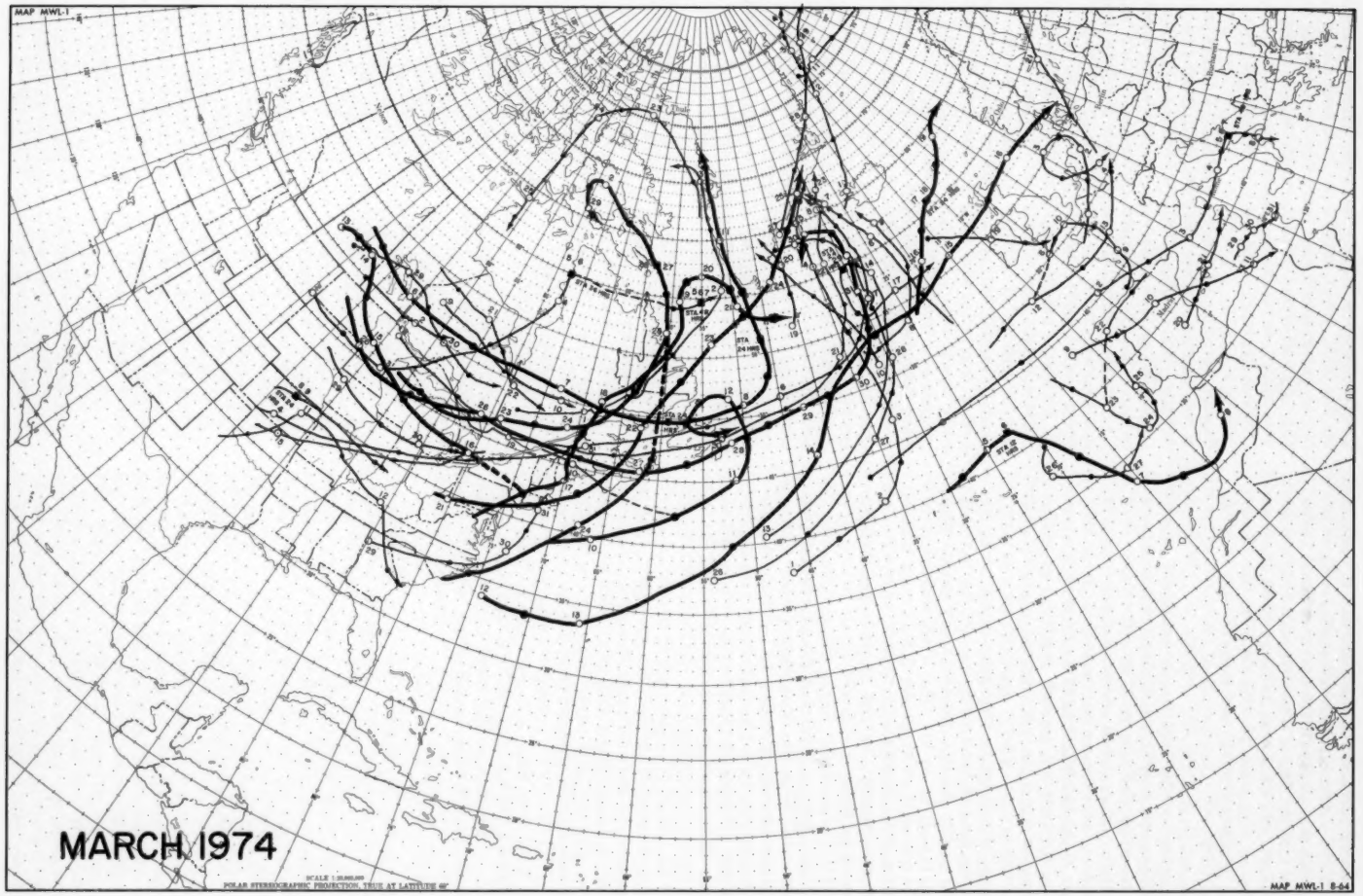


Figure 27. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

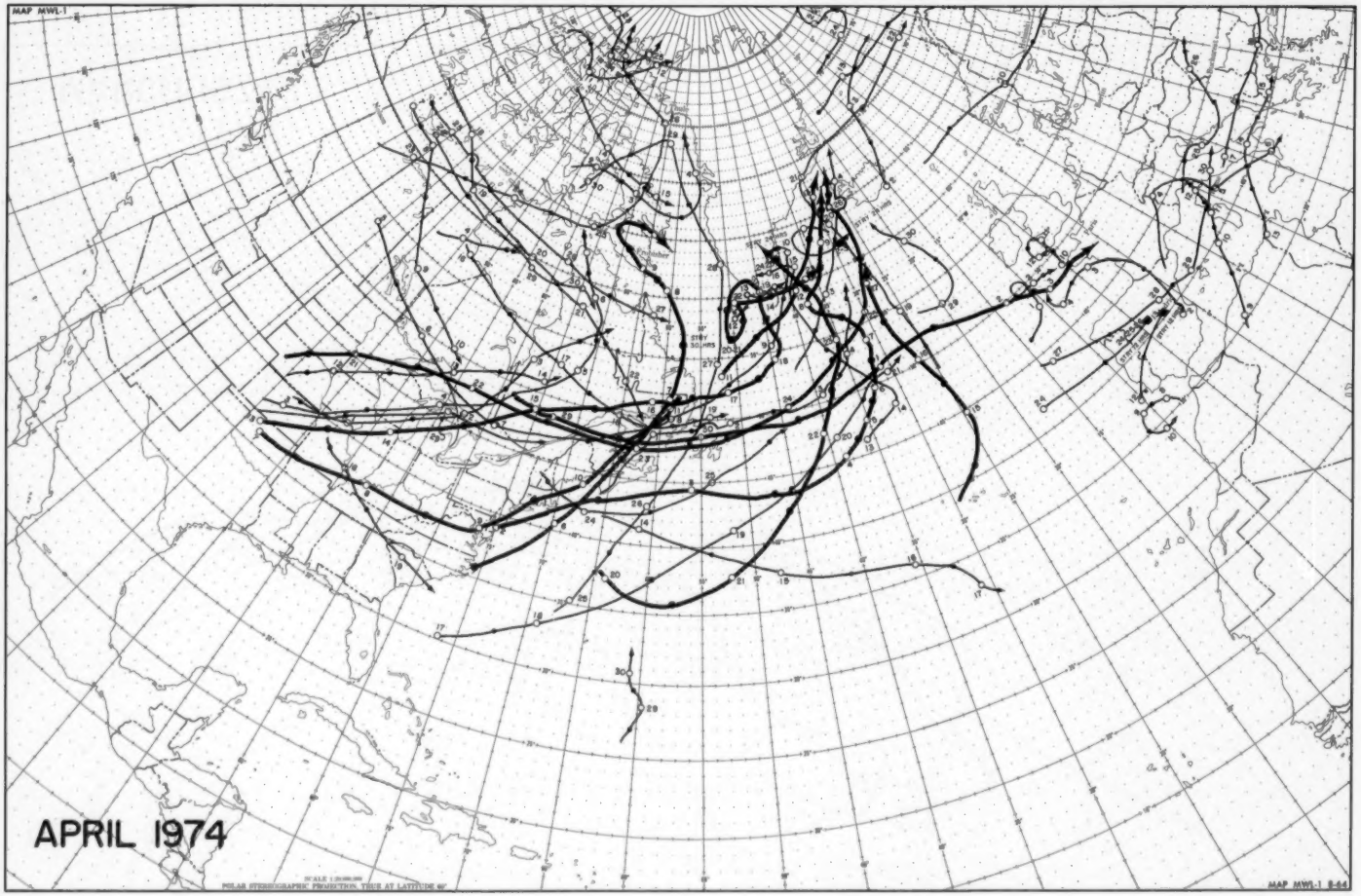


Figure 28.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

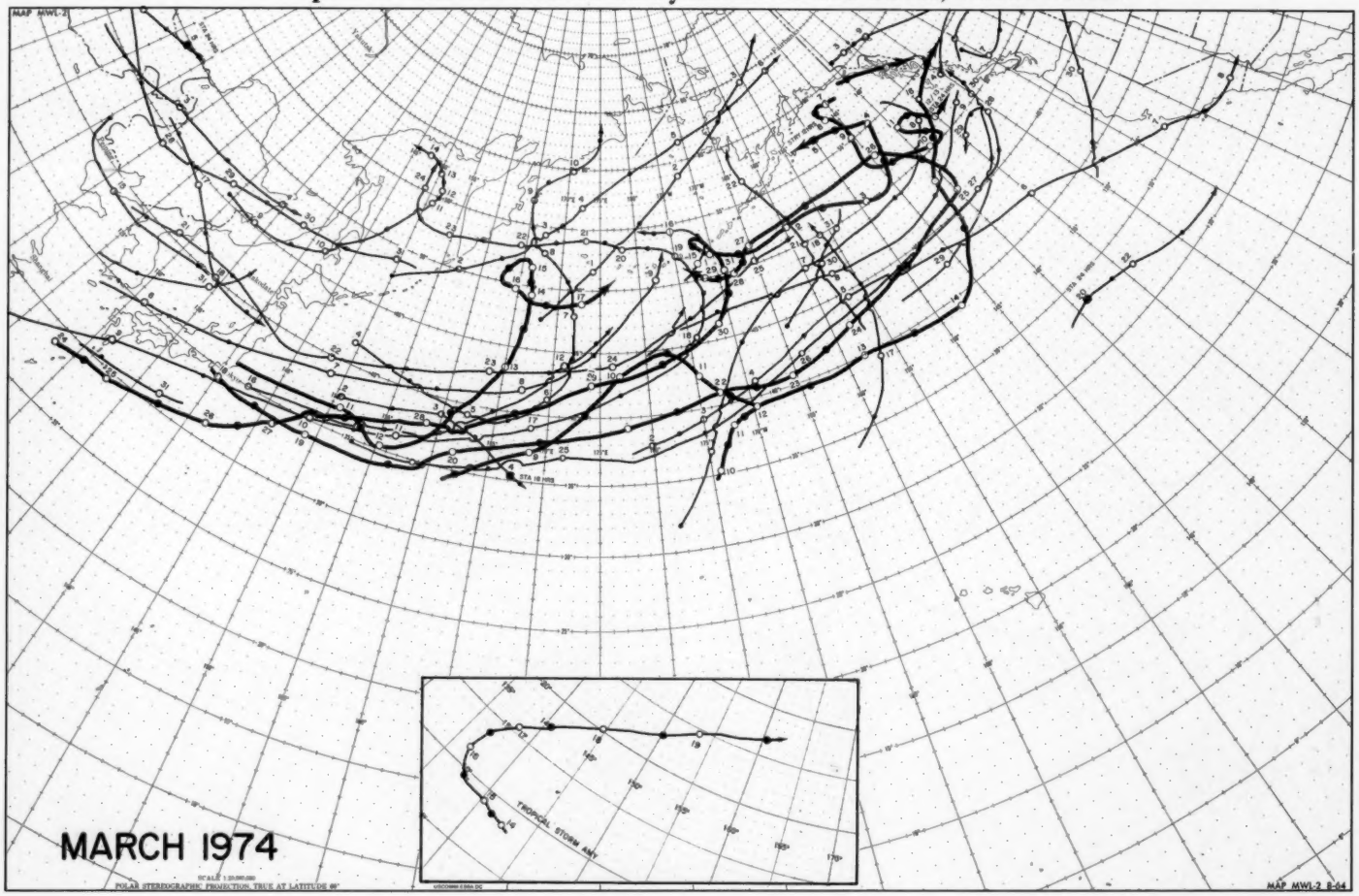


Figure 29.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

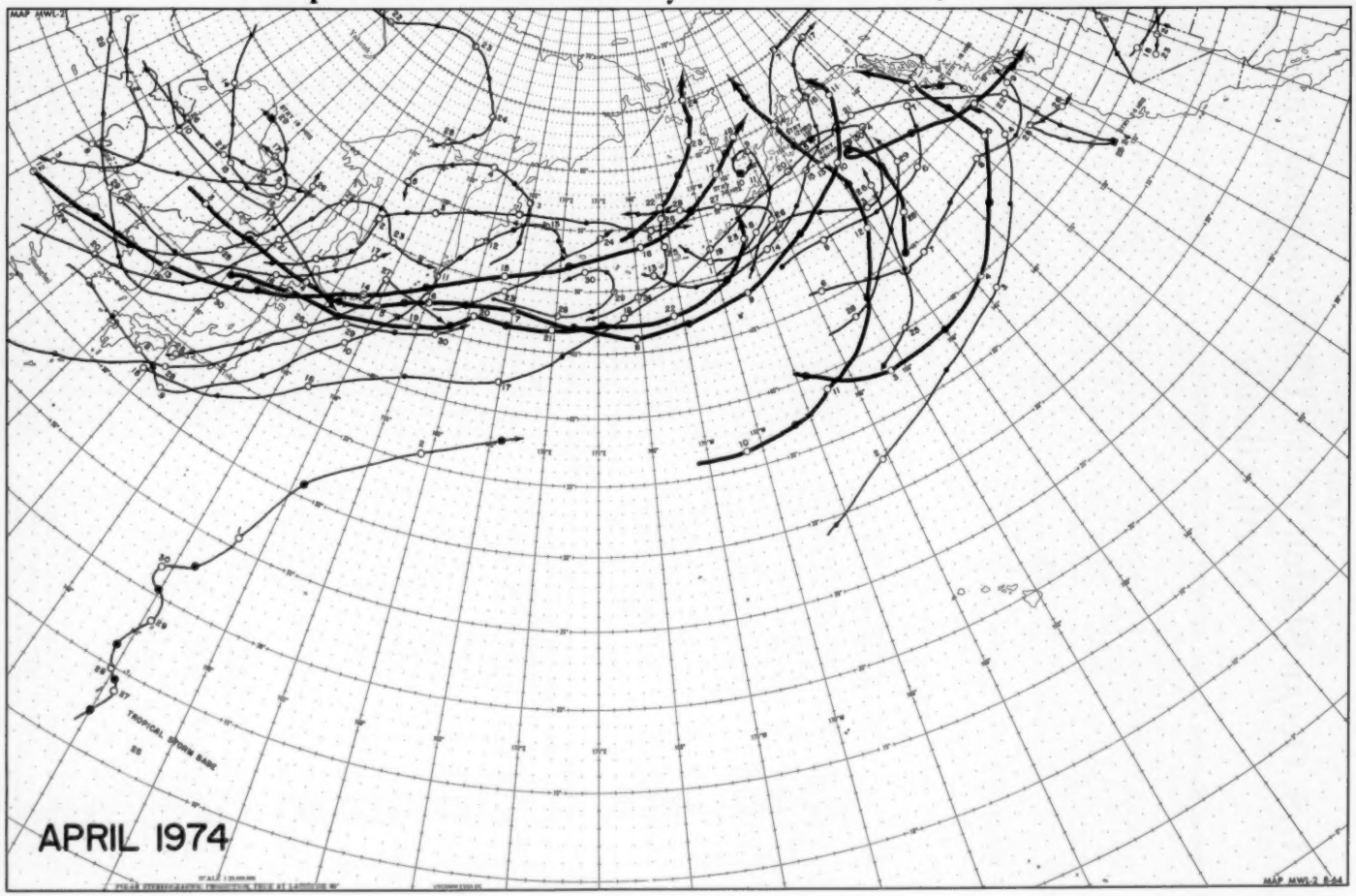


Figure 30.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 5
U.S. Ocean Station Vessel Climatological Data, North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W — **March and April, 1974**

MEANS AND EXTREMES

	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
MONTH	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
MAR	-10.0	26 09	- 2.1	9.4	23 13	-12.9	22 13	- 5.1	2.5	23 15	.3	26 15	2.7	3.9	07 06	-11.8	26 09	- 4.7	.5	*23 18
APR	- 5.7	29 06	.6	4.0	29 21	-11.3	29 00	- 2.8	2.8	21 18	.6	17 18	2.4	3.9	18 03	- 7.4	29 06	- 1.8	2.3	18 15

	MEANS AND EXTREMES					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS)									DAYS WITH SPECIFIED WEATHER								
	PRESSURE (MB)					TOTAL CLOUD					LOW CLOUD				RAIN OR				VSBY <1KM	WIND (KTS)			COMP OB	SOBS WITH	NO OF
MONTH	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	DRIZ	SNOW	TSTM	**	≥34	≥48	≥64	DAYS	PCPN	OBS
MAR	962.8	09 06	994.9	1021.1	24 15	3.0	8.5	38.8	49.7	9.7	27.9	38.8	23.6	29	27	27	0	4	20	8	0	13	49.7	165
APR	968.1	17 09	1007.0	1022.6	26 15	2.1	10.6	32.4	54.9	8.5	21.1	48.1	20.3	19	13	10	0	1	3	1	0	15	27.5	142

** VV-DQ-03 AND/OR N=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

MAR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	1.7	.0	3.2	.6	5.5	34.3
NE	.0	1.8	.2	1.2	3.3	.0	6.5	26.7
E	.0	.0	3.4	3.3	2.3	.6	9.7	28.5
SE	.0	1.2	3.0	1.1	1.2	.0	6.5	21.3
S	.5	.8	2.9	4.3	2.3	.0	10.8	24.2
SW	.2	.6	5.3	8.3	5.5	.2	20.2	27.5
W	.0	1.2	7.9	8.7	5.2	1.7	22.6	27.1
NW	.0	.6	5.9	3.9	5.6	.6	17.7	31.2
CALM	.6	.0	.0	.0	.0	.0	.6	.0
TOTAL	1.2	6.1	28.5	29.1	31.5	3.6	100.0	27.4

NUMBER OF OBS 165 — MAX WIND SPEED 58, DIR 260, DA HR 21 1500 — VECTOR SPEED 9.6 — MEAN DIR 244 (DIR IN DEGREES)

APR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.7	6.3	3.2	1.6	.5	12.3	23.6
NE	.0	.7	5.9	1.6	2.6	.2	10.9	24.1
E	.0	1.2	.8	1.9	4.0	.0	7.7	29.2
SE	.0	.4	1.8	1.6	2.3	.0	6.0	28.0
S	.0	4.0	1.6	.5	.0	.0	6.2	10.7
SW	.0	3.5	7.0	.0	.0	.0	10.6	12.3
W	.0	1.2	14.1	2.8	.0	.0	18.1	18.4
NW	.0	1.6	19.2	7.4	.0	.0	28.2	18.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	13.4	56.3	19.0	10.6	.7	100.0	19.6

NUMBER OF OBS 142 — MAX WIND SPEED 50, DIR 020, DA HR 02 2000 — VECTOR SPEED 6.2 — MEAN DIR 340 (DIR IN DEGREES)

Wave

MAR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.0	.6	1.2	3.3	1.5	.0	.0	6.6
NE	.0	.0	1.2	1.8	3.3	2.1	.0	.0	8.5
E	.0	.5	2.0	1.2	1.1	.0	.0	1.8	6.7
SE	.0	.8	3.0	2.4	1.2	.0	.0	.0	7.3
S	.0	1.1	2.3	2.4	2.1	.0	.0	.0	7.9
SW	.0	.2	2.3	3.2	7.4	.0	.0	.8	13.9
W	.0	2.3	8.8	3.2	10.3	.0	.0	.0	24.5
NW	.0	.8	4.1	3.9	5.0	3.0	.0	.0	16.8
IND	.0	.5	4.8	.6	.6	.0	.0	.0	6.7
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	6.1	29.1	20.0	36.4	6.7	.0	1.8	100.0

NUMBER OF OBS 165 — IND=INDETERMINATE

APR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	5.1	1.9	1.2	2.8	.0	.0	.0	11.1
NE	.0	3.0	2.8	1.6	2.1	.0	.0	.0	9.5
E	.0	1.1	.0	.5	5.5	.0	.0	.0	7.0
SE	.0	1.2	1.6	2.1	.9	.0	.0	.0	5.8
S	.0	3.7	.5	.0	.0	.0	.0	.0	4.2
SW	.7	7.7	2.1	.0	.0	.0	.0	.0	10.6
W	.0	7.4	2.5	.0	.5	.0	.0	.0	10.4
NW	.0	7.4	13.3	.9	.2	.0	.0	.0	23.8
IND	.0	5.6	2.8	7.0	2.1	.0	.0	.0	17.6
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.7	42.3	29.6	13.4	14.1	.0	.0	.0	100.0

NUMBER OF OBS 142 — IND=INDETERMINATE

MAR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	4.8	6.1	.6	.0	.0	.0	.0	11.5
6-7	.0	.6	8.5	8.5	4.8	.0	.0	.0	22.4
8-9	.0	.0	9.7	7.9	18.2	4.8	.0	1.8	41.8
10-11	.0	.0	.0	3.0	11.5	.6	.0	.0	15.2
12-13	.0	.0	.0	.0	1.2	1.2	.0	.0	2.4
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.6	4.8	.6	.6	.0	.0	.0	6.7
TOTAL	.0	6.1	29.1	20.0	36.4	6.7	.0	1.8	100.0

NUMBER OF OBS 165 — MAX WAVE HEIGHT 11.0, PER 9, DIR 090, TYPE SEA, DA HR 12 18 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

APR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.7	32.4	10.6	.0	.0	.0	.0	.0	43.7
6-7	.0	4.2	14.1	0.3	2.1	.0	.0	.0	20.8
8-9	.0	.0	2.1	.0	9.2	.0	.0	.0	11.3
10-11	.0	.0	.0	.0	.7	.0	.0	.0	.7
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	3.6	2.8	7.0	2.1	.0	.0	.0	17.6
TOTAL	.7	42.3	29.6	13.4	14.1	.0	.0	.0	100.0

NUMBER OF OBS 142 — MAX WAVE HEIGHT 9.3, PER 9, DIR 040, TYPE SEA, DA HR 02 09 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 6
CLIMATOLOGICAL DATA

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — March and April, 1974

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
MAR	4.0	19 12	13.4	22.0	21 21	- 2.9	11 12	8.8	19.6	21 21	13.4	21 00	19.0	25.0	26 04	-17.8	13 18	- 5.6	4.0	05 09
APR	7.9	07 12	10.9	24.2	19 09	- 2.7	11 12	12.0	21.3	19 06	13.6	01 15	21.6	29.5	19 12	-13.1	10 18	- 4.7	1.8	02 18

MONTH	MEANS AND EXTREMES — PRESSURE (MB)					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) — TOTAL CLOUD				LOW CLOUD				DAYS WITH SPECIFIED WEATHER							COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	RAIN OR PCPN	DRIZ	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64			
MAR	988.2	30 21	1014.7	1029.6	25 18	9.3	17.5	23.7	49.5	32.5	28.9	17.0	21.6	21	20	9	2	0	12	2	0	19	14.9	194
APR	999.6	01 00	1014.8	1030.2	12 00	7.4	16.4	32.0	44.3	33.2	35.2	18.0	11.5	9	9	0	1	0	9	1	0	15	10.7	122

** VV-90-93 AND/OR W-4 — COMP OB DAYS=COMPLETE OB DAYS

Wind

MAR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	3.5	7.7	.5	.5	.0	12.2	14.1
NE	.0	2.2	6.6	1.8	.6	.0	11.2	17.3
E	.0	1.3	5.7	3.4	1.7	.5	12.5	22.1
SE	.3	1.0	1.7	1.7	.8	.0	5.7	18.3
S	.5	.0	1.9	1.4	.9	.0	4.8	21.8
SW	.0	1.0	3.7	5.8	3.9	.1	14.6	26.3
W	.0	1.8	3.1	5.7	4.3	.4	15.2	25.9
NW	.0	1.0	4.8	7.6	3.9	.0	22.3	22.6
CALM	1.5	.0	.0	.0	.0	.0	1.5	.0
TOTAL	2.6	11.9	40.2	27.8	16.5	1.0	100.0	21.4

NUMBER OF OBS	MAX WIND DIR	MAX WIND SPEED	MAX WIND DA HR	VECTOR MEAN SPEED	VECTOR MEAN DIR	(DIR IN DEGREES)
194	100	62	30 1038	5.8	299	

APR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.6	4.5	.8	.0	.0	6.9	13.8
NE	.0	2.5	.2	.0	.0	.0	2.7	7.1
E	.0	.0	.8	.6	.0	.0	1.4	16.7
SE	.0	.8	1.6	1.8	.0	.0	4.3	19.0
S	.0	.6	4.1	12.3	8.8	.8	26.6	29.0
SW	.8	3.7	3.5	10.7	1.8	.0	20.3	21.3
W	.0	2.9	6.1	9.4	1.4	.0	19.9	20.7
NW	.0	1.0	7.4	9.3	3.1	.0	18.9	24.4
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.8	13.1	27.9	45.2	17.2	.8	100.0	22.8

NUMBER OF OBS	MAX WIND DIR	MAX WIND SPEED	MAX WIND DA HR	VECTOR MEAN SPEED	VECTOR MEAN DIR	(DIR IN DEGREES)
122	180	54	09 1100	12.7	236	

Wave

MAR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	9.3	3.0	.0	.9	.0	.0	.0	13.1
NE	.0	6.6	3.1	.9	.5	.0	.0	.0	11.1
E	.0	3.1	1.3	3.2	2.3	1.0	.5	.0	11.7
SE	.3	.8	1.3	.5	.8	.3	.0	.0	4.4
S	.0	4.6	1.0	.8	.0	.0	.0	.0	6.4
SW	.0	4.9	2.1	4.4	4.9	.1	.0	.0	16.4
W	.4	1.7	1.9	2.3	4.9	1.3	.0	.0	12.5
NW	.1	5.7	5.9	5.9	2.7	.6	.0	.0	19.9
IND	.0	4.6	.3	.0	.0	.0	.0	.0	5.2
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.0	41.2	20.6	18.0	17.0	3.6	.5	.0	100.0

NUMBER OF OBS 194 — IND=INDETERMINATE

APR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.4	.0	.0	.0	.0	.0	.0	1.4
NE	.0	.2	.0	.0	.0	.0	.0	.0	.2
E	.0	.0	.6	.0	.0	.0	.0	.0	.6
SE	.0	.0	1.0	.8	.0	.0	.0	.0	1.8
S	.0	3.3	5.5	12.9	10.2	2.3	.0	.0	33.8
SW	.0	1.0	7.0	9.8	1.2	.0	.0	.0	19.1
W	.0	5.3	3.1	3.1	1.4	.6	.0	.0	13.6
NW	2.5	2.7	4.9	7.2	2.7	1.0	.0	.0	20.9
IND	1.6	4.1	.8	.0	.0	.0	.0	.0	6.6
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.1	18.0	23.0	35.2	15.6	4.1	.0	.0	100.0

NUMBER OF OBS 122 — IND=INDETERMINATE

MAR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	1.0	30.4	6.2	.0	.0	.0	.0	.0	37.6
6-7	.0	6.2	12.4	14.9	7.2	.0	.0	.0	40.7
8-9	.0	.0	1.5	1.0	9.8	3.6	.5	.0	16.5
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	4.6	.5	.0	.0	.0	.0	.0	5.2
TOTAL	1.0	41.2	20.6	18.0	17.0	3.6	.5	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
194	8.0	9	080	SEA	30 13	(DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

APR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	2.5	10.7	9.8	1.6	.0	.0	.0	.0	24.6
6-7	.0	2.5	9.0	29.5	3.3	.0	.0	.0	44.3
8-9	.0	.8	3.3	4.1	12.3	4.1	.0	.0	24.6
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	1.6	4.1	.8	.0	.0	.0	.0	.0	6.6
TOTAL	4.1	18.0	23.0	35.2	15.6	4.1	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
122	6.9	9	170	SEA	09 12	(DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 7
Selected Gale Observations, North Atlantic
March and April 1974

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH ATLANTIC		MAR.															
SS CHARLESTON	AMERICAN	1	38.6 N	72.7 W	18	32	45	10 NM	02	1011.3	5.5	11.0	5	13	27	12	16.5
MV MAGLEBY MAERSK	DANISH	2	49.0 N	13.8 W	12	32	50	1 NM		1006.7	8.6	13.0					
SS SEALAND ECONOMY	AMERICAN	5	39.7 N	28.8 W	18	32 M	55	1 NM	65	994.0	6.8	14.4	6	19.5	32	13	32.5
SS AFRICAN SUN	AMERICAN	5	39.9 N	66.5 W	12	23	45	5 NM	05	1013.9	17.2	15.6			23	< 6	14.5
SS JOSEPH LYKES	AMERICAN	5	35.3 N	26.8 W	12	32	50	5 NM	18	1010.5	12.2	17.8	3	10			
SS SEALAND VENTURE	AMERICAN	8	38.8 N	38.8 W	18	19 M	45	10 NM	03	1013.2	16.7	17.8	5	8	17	7	11.5
SS SEALAND VENTURE	AMERICAN	9	40.3 N	34.6 W	06	21 M	45	5 NM	80	1006.2	13.6	15.0	6	10			
SS AMER ACCORD	AMERICAN	9	47.7 N	31.5 W	12	18	45	1 NM		994.0	10.7	11.2			20	8	16.5
SS AMER ACE	AMERICAN	9	48.3 N	30.4 W	12	16	48	.25 NM	27	995.6	11.7	10.6	6	24.5	16	9	32.5
SS SEALAND MC LEAN	AMERICAN	10	41.5 N	42.3 W	00	28	45	.5 NM	64	1003.7	10.0	17.8	10	8	27	>13	8
USCGC DALLAS	AMERICAN	10	41.4 N	68.4 W	18	31 M	44	5 NM	03	1002.2	4.0	5.0	3	8			
SS GREAT REPUBLIC	AMERICAN	11	40.1 N	50.4 W	12	26	50	1 NM	64	981.8	4.0	5.5	5	13	26	X	23
MV SNOW FLOWER	SWEDISH	11	38.7 N	52.9 W	12	29	47	2 NM	81	987.6	8.0		12	16.5			
USCGC DALLAS	AMERICAN	11	41.3 N	68.8 W	00	32 M	48	5 NM	03	1011.4	1.5	5.0					
SS AMER ACE	AMERICAN	11	44.6 N	47.3 W	18	20	75	.5 NM		959.8	- 0.5	7.8	7	28	20	9	39
MV EDE SOTTORF	GERMAN	11	37.5 N	43.9 W	18	23	42	2 NM	82	992.9	19.0		6	11.5			
MV ATLANTICA LIVORNO	GERMAN	11	41.2 N	61.7 W	12	33	60	5 NM	90	1001.0	0.0	12.0	6	14.5	35	10	29.5
SS CHARLOTTE LYKES	AMERICAN	11	36.1 N	49.2 W	18	26	50	5 NM	02	997.0	13.6	15.0	3	8	26	8	21
SS WARRIOR	AMERICAN	11	40.1 N	59.8 W	12	29	50	1 NM	87	1001.5	2.2	17.7	6	11.5	23	7	13
MV TAIKO	NORWEGIAN	11	35.2 N	65.8 W	12	33	42	5 NM	02	1018.0	12.0	21.5	XX	28			
SS SEALAND MC LEAN	AMERICAN	11	40.5 N	60.0 W	12	33	65	5 NM	02	1000.3	1.8	13.0	13	26	32	>13	29.5
SS AMER ACE	AMERICAN	12	44.5 N	48.7 W	00	25	55	.25 NM	88	974.6	- 1.7	2.2	7	37.5	25	9	41
MV ATLANTICA LIVORNO	GERMAN	12	41.5 N	53.4 W	00	32	55	5 NM	88	1007.0	0.0		12	16.5	34	10	19.5
MV EDE SOTTORF	GERMAN	12	37.5 N	44.7 W	00	27	52	2 NM	01	997.3	13.6		12	44			
SS EXPORT CHAMPION	AMERICAN	12	35.6 N	47.0 W	00	25	50	5 NM	21	1004.1	13.3	15.2	4	13	25	< 6	16.5
MV SNOW FLOWER	SWEDISH	12	38.0 N	48.0 W	00	28	45	5 NM	90	997.6	10.6	18.5	12	21			
SS LASH ESPANA	AMERICAN	13	34.8 N	70.9 W	12	03 M	45	5 NM	60	1003.0	8.3	18.7	2	8	04	7	10
SS EXPORT FREEDOM	AMERICAN	14	38.9 N	43.1 W	12	23	50	1 NM	65	1005.5	14.2	17.3	12	23			
MV FERNDALE	NORWEGIAN	14	38.1 N	48.0 W	06	26	45	5 NM	81	995.5	15.0		10	19.5			
MV BELHUDSON	BRITISH	14	36.0 N	25.0 W	12	24 M	45	10 NM	70	993.5	5.0		2	6.5	24	6	13
MV ATLANTIC FOREST	NORWEGIAN	14	36.4 N	49.9 W	00	20 M	45	5 NM	02	998.0	19.5			14.5	24	X	24.5
MV DRAGOR MAERSK	DANISH	14	19.7 N	18.1 W	12	04	41	5 NM	00	1014.0	21.1	18.0			04	6	10
SS STAGHOUND	AMERICAN	14	40.3 N	38.3 W	12	19	47	5 NM	02	1005.8	14.3	14.4	4	10	23	8	29.5
MV FALSTRIA	DANISH	15	52.2 N	15.1 W	12	27	45	2 NM	03	989.5	14.0		10	29.5			
MV BELHUDSON	BRITISH	16	50.1 N	38.9 W	18	27 M	47	> 25 NM	16	997.2	4.2	8.0			28	6	19.5
MV FERNFIELD	NORWEGIAN	17	36.1 N	62.4 W	18	20	43	2 NM	64	1006.5	17.2		8	13			
SS STAGHOUND	AMERICAN	17	40.8 N	63.5 W	12	17	50	2 NM	64	1003.4	12.8	15.0			17	7	16.5
SS MOBIL AERO	AMERICAN	18	39.8 N	72.1 W	12	28	50	10 NM	01	1000.3	3.8	8.4	12	16.5	33	9	13
MV FERNFIELD	NORWEGIAN	18	36.6 N	51.0 W	00	28	50	2 NM	90	1003.2	18.6		9	14.5			
SS ADM W M CALLAGHAN	AMERICAN	18	37.3 N	62.8 W	06	27	45	5 NM	29	1000.0	14.4	20.0			26	8	19.5
SS AMER LEGACY	AMERICAN	18	48.3 N	25.7 W	18	31	45	5 NM	76	1011.0	4.3	12.3	5	13	32	7	24.5
SS SEALAND VENTURE	AMERICAN	18	47.4 N	11.0 W	00	28 M	42	10 NM	19	1001.7	8.9	11.1					
USCGC EDISTO	AMERICAN	19	36.0 N	34.8 W	00	11 M	32	2 NM	61	997.6	2.2	5.7	8	8			
SS ADM W M CALLAGHAN	AMERICAN	19	39.5 N	69.5 W	06	29	45	5 NM	03	1007.0	4.7	13.0	7	19.5			
MV NORBROTT	NORWEGIAN	20	37.0 N	59.1 W	12	24	45	10 NM	02	1012.0	18.0	21.0	7	16.5			
MV MELVIN H BAKER	LIBERIAN	22	43.9 N	64.3 W	06	22	55	200 YD	95	996.0	1.0	1.0	10	16.5			
SS MOBIL POWER	AMERICAN	22	36.5 N	72.4 W	00	21	45	5 NM	58	1005.1	20.0	20.0	XX	8	21	X	13
SS TILLIE LYKES	AMERICAN	23	36.9 N	28.1 W	06	33	45	10 NM	16	1024.4	12.7	19.0	4	11.5	33	7	16.5
SS EXPORT PATRIOT	AMERICAN	24	44.8 N	43.5 W	00	31	48	10 NM	02	1032.9	4.3	14.5			30	8	8
SS AMER ACCORD	AMERICAN	24	46.4 N	39.1 W	06	29	45	10 NM	07	1032.0	5.0	11.7	4	6.5	29	7	14.5
SS SEALAND MC LEAN	AMERICAN	24	40.6 N	59.4 W	18	18	45	1 NM		1013.9	14.4	18.3	10	16.5	18	>13	19.5
SS RIO ORINOCO	LIBERIAN	25	35.6 N	30.4 W	12	32	41	10 NM	02	1025.4	13.9	16.1	10	19.5			
MV FAVORITA	LIBERIAN	25	43.8 N	23.4 W	12	01	45	5 NM	15	1012.0	7.5	16.7	4	6.5	36	6	14.5
SS TETELA	HONDURAN	25	41.5 N	26.6 W	12	34	50	10 NM	02	1013.0	11.0	12.0	4	10	34	8	23
USNS NORWALK T AK 279	AMERICAN	26	35.3 N	32.1 W	00	34 M	46	10 NM	01	1021.7	10.0	17.3	4	11.5	02	6	11.5
MV CARMEN	SWEDISH	26	45.2 N	43.6 W	06	27	50	1 NM		1018.0	4.0	11.0		21			
MV MARCONA TRANSPORTER	LIBERIAN	27	41.8 N	63.8 W	12	30	48	10 NM	14	1006.5	2.8	12.0	8	13			
SS AMER ACCORD	AMERICAN	27	41.6 N	65.2 W	12	32	47	10 NM	01	1009.2	1.7	11.7	5	6.5			
MV CARMEN	SWEDISH	28	42.3 N	36.4 W	12	30	55	2 NM	23	1003.5	2.0	5.0	12	26			
SS AMER LEGEND	AMERICAN	28	39.1 N	51.2 W	12	29	45	5 NM	25	1009.1	10.0	16.7	4	13			
SS SEALAND MC LEAN	AMERICAN	28	41.2 N	55.8 W	12	29	45	5 NM	02	1008.8	3.3	8.9	10	23	31	>13	24.5
USCGC CHASE	AMERICAN	29	44.5 N	36.5 W	12	32 M	44	.5 NM	83	998.0	- 4.1	- 1.7	8	16.5			
SS AMER LEGACY	AMERICAN	29	53.3 N	28.2 W	06	33	54	1 NM	73	979.0	3.4	5.0	5	21	25	6	24.5
MV CARMEN	SWEDISH	29	41.5 N	57.3 W	06	30	50	2 NM	23	1004.0	1.0	14.0		26			
SS SEALAND MARKET	AMERICAN	29	45.2 N	32.4 W	12	18	41	5 NM	02	1000.3	13.9	11.7	8	10	23	10	13
SS PONCE DE LEON	AMERICAN	30	37.2 N	72.8 W	18	23	42	10 NM	01	988.8	22.2	14.0	6	10	09	10	16.5
SS LIGHTNING	AMERICAN	30	46.5 N	31.5 W	12	21	43	10 NM	15	996.4	10.0	11.7	6	14.5	20	11	21
SS SEALAND MARKET	AMERICAN	30	42.9 N	38.1 W	18	28	49	2 NM	18	1009.1	10.0	12.8	8	10			
SS AMER LEGACY	AMERICAN	30	48.0 N	36.8 W	12	29	45	5 NM	03	984.8	5.5	10.0	5	19.5	29	6	24.5
SS SOCONY VACUUM	AMERICAN	31	34.3 N	75.6 W	18	31	45	> 25 NM	00	1002.1	21.1	22.2	5	10			
SS MOBIL ARCTIC	AMERICAN	31	35.7 N	70.3 W	18	25	45	10 NM	02	997.3	14.7	18.3	8	8	27	6	13
SS AMER LEGACY	AMERICAN	31	46.0 N	39.4 W	00	30	48	5 NM	18	1010.5	7.3	13.3	5	19.5	30	6	24.5
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC CAMPBELL	AMERICAN	3	56.5 N	51.0 W	12	30 M	45	5 NM	15	998.8	- 7.4	2.2	8	19.5			
USCGC CAMPBELL	AMERICAN	9	56.6 N	49.7 W	00	33 M	50	2 NM	71	972.0	0.0	3.2	8	19.5			
USCGC CAMPBELL	AMERICAN	12	56.6 N	51.4 W	12	08 M	48	.5 NM	81	978.8	1.8	3.2	9	32.5			
USCGC DUANE	AMERICAN	18	55.3 N	50.1 W	21	13 M	44	.5 NM	71	983.6	1.2	3.0	8	13			
USCGC DUANE	AMERICAN	21	56.5 N	51.2 W	15	26 M	38	.25 NM	71	990.0	- 5.9	2.0	9	16.5			
USCGC DUANE	AMERICAN	22	56.4 N	50.7 W	00	30 M	45	2 NM	07	999.4	- 3.0	2.8	9	16.5			
USCGC DUANE	AMERICAN	23	56.4 N	50.9 W	21	32 M	49	50 YD	73	987.9	- 1.0	2.6	7	11.5			
USCGC DUANE	AMERICAN	26	56.6 N	50.7 W	00	31 M	47	2 NM	07	982.4	1.8	2.7	10	16.5			
USCGC DUANE	AMERICAN	27	56.6 N	50.7 W	00	24 M	43	2 NM	85	999.0	- 4.8	2.0	10	16.5			
USCGC DUANE	AMERICAN	29	56.5 N	51.0 W	18	36 M	41	5 NM	02	997.0	0.0	3.1	5	10	02	11	18

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb	Temperature °F		Sea Waves*			Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH ATLANTIC OCEAN		MAR.																
ATLANTIC H																		
USCGC TANEY	AMERICAN	1	38.0 N	71.0 W	12	23	M 30	5	NM	07	1014.3	14.8	15.9	8	16.5			
USCGC TANEY	AMERICAN	10	38.0 N	71.0 W	21	33	M 42	5	NM	05	1013.7	10.4	20.8	7	13			
USCGC INGHAM	AMERICAN	18	37.9 N	71.2 W	12	32	M 41	10	NM	03	1003.9	4.0	14.4	6	13			
USCGC INGHAM	AMERICAN	21	37.8 N	70.8 W	21	22	M 42	8	NM	02	998.8	22.0	22.8	6	10			
USCGC TANEY	AMERICAN	30	38.0 N	71.0 W	12	09	M 37	1	NM	03	994.1	17.9	22.3	8	19.5			
NORTH ATLANTIC		APR.																
SS MOBIL ARCTIC	AMERICAN	1	35.7 N	72.0 W	06	28	45	10	NM	02	1001.8	13.6	18.3	3	8	28	6	13
SS ULTRAMAR	AMERICAN	1	48.3 N	15.3 W	18	33	42	10	NM	02	1003.7	9.3	9.5	7	16.5	33	9	23
USCGC CHASE	AMERICAN	2	54.4 N	49.4 W	15	04	M 44	5	NM	02	995.8	3.8	2.2	8	16.5			
SS ULTRAMAR	AMERICAN	4	44.1 N	38.8 W	12	21	35	5	NM	02	991.9	10.0	10.6	8	19.5			
MV MARCONA TRANSPORTER	LIBERIAN	6	37.2 N	70.6 W	12	19	41	2	NM	03	1002.2	20.6	23.0	9	10			
SS ESSO NEW ORLEANS	AMERICAN	9	34.9 N	74.2 W	18	25	45	2	NM	01	1005.0	23.8	24.4	6	8	22	7	11.5
ULTRAMAR	AMERICAN	15	46.7 N	23.9 W	18	13	34	5	NM	20	997.0	12.2	10.0	8	41			
SS ULTRAMAR	AMERICAN	16	46.4 N	23.4 W	00	20	37	2	NM	20	1002.5	10.0	10.0	7	29.5	14	7	32.5
SS AMER LEGACY	AMERICAN	16	48.2 N	27.6 W	12	29	48	5	NM	02	1002.0	4.1	12.3	3	13	32	7	24.5
SS PONCE DE LEON	AMERICAN	18	33.7 N	71.3 W	18	36	45	10	NM	82	1012.8	17.2	21.6	8	8	36	10	16.5
MV NEONIA	DANISH	18	43.5 N	31.7 W	06	18	45	8	NM	72	1007.5	14.4		4	11.5	XX	X	26
SS NAUMEE	AMERICAN	22	42.0 N	47.6 W	00	32	35	5	NM	21	1004.1	4.7	13.9	6	10	01	8	19.5
MV EDE SOTTORF	GERMAN	22	35.8 N	51.6 W	00	32	45	5	NM	02	1014.6	12.8		6	6.5	33	12	16.5
MV EDE SOTTORF	GERMAN	24	36.5 N	64.6 W	12	22	41	5	NM	15	1009.1	19.9		5	6.5	22	9	13
SS ATLANTIC ENTERPRISE	AMERICAN	25	36.1 N	74.5 W	18	36	48	10	NM	03	1018.6	12.0	26.7	9	18			
MV MAGLEBY MAERSK	DANISH	27	43.3 N	17.1 W	18	35	42	5	NM	02	1008.0	12.2	13.0	5	11.5			
OCEAN STATION VESSELS																		
ATLANTIC B																		
USCGC DUANE	AMERICAN	2	54.9 N	49.6 W	18	02	M 49	5	NM	07	998.0	0.5	3.4	9	18			
USCGC CHASE	AMERICAN	17	56.5 N	51.0 W	03	12	M 45	2	NM	01	992.5	2.6	2.8	7	13			
ATLANTIC H																		
USCGC TANEY	AMERICAN	1	38.0 N	71.0 W	00	29	M 42	5	NM	07	999.6	11.2	20.7	9	19.5			
USCGC TANEY	AMERICAN	6	38.0 N	71.0 W	00	25	43	5	NM	07	1006.8	21.6	21.9	9	18			
USCGC TANEY	AMERICAN	9	38.0 N	71.0 W	12	17	30	5	NM	07	1005.6	20.1	22.0	9	21			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 8
U.S. Ocean Station Vessel Climatological Data, North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W **March and April, 1974**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
MAR	14.7	03 12	17.6	20.1	15 00	3.8	08 12	12.8	18.3	*29 00	16.8	12 18	18.4	19.8	17 00	- 3.8	15 18	- .8	2.0	*29 00
APR	15.3	24 03	17.9	20.2	*04 12	4.8	23 18	11.0	18.1	*27 12	17.8	16 09	18.8	20.0	03 00	- 4.1	24 03	- 1.3	1.7	04 15

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR PCPN	DREZ	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
MAR	1008.4	24 12	1019.8	1033.7	05 18	16.9	19.4	37.9	25.8	33.9	27.4	27.4	11.3	16	16	0	0	0	1	0	0	6	13.7	124
APR	1014.2	04 15	1026.1	1041.7	11 21	7.5	15.0	28.6	48.8	23.9	14.6	21.1	40.4	4	4	0	0	0	0	0	0	22	3.8	213

** VV-90-93 AND/OR W=4 COMP OB DAYS-COMPLETE OB DAYS

Wind

MAR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	6.0	4.4	1.4	.0	.0	11.9	12.7
NE	.0	3.0	13.1	.8	.0	.0	16.9	14.9
E	.0	2.0	4.0	.0	.0	.0	6.0	12.9
SE	.0	.4	.2	.8	.0	.0	1.4	20.1
S	.0	3.8	5.6	0.9	.0	.0	10.3	18.4
SW	.0	2.0	12.1	4.6	.0	.0	18.8	17.9
W	.0	0.9	7.9	2.2	.0	.0	10.9	13.7
NW	.8	2.4	4.2	1.0	.0	.0	8.5	13.4
CALM	3.2	.0	.0	.0	.0	.0	3.2	.0
TOTAL	4.0	20.6	51.4	17.7	.0	.0	100.0	15.1

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
124	240	35	29	1700	3.4	248	

APR — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.3	6.2	1.3	.0	.0	8.8	15.1
NE	.5	3.1	20.1	11.7	.0	.0	35.3	17.4
E	.5	7.4	23.2	5.8	.0	.0	36.9	15.3
SE	.0	2.3	4.8	.9	.0	.0	7.2	12.4
S	.0	.0	1.3	.8	.0	.0	2.1	19.2
SW	.0	.5	.0	.1	.0	.0	.6	9.8
W	.4	.0	.8	.8	.0	.0	2.0	18.1
NW	.1	.9	1.3	.1	.0	.0	2.3	12.2
CALM	4.7	.0	.0	.0	.0	.0	4.7	.0
TOTAL	6.1	15.5	57.7	20.7	.0	.0	100.0	15.4

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
213	290	33	04	1800	11.6	064	

Wave

MAR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	5.0	1.2	.0	.0	.0	.0	.0	6.3
NE	.0	7.9	2.2	.0	.0	.0	.0	.0	10.1
E	.8	9.3	1.2	.0	.0	.0	.0	.0	11.3
SE	.0	.2	.8	.0	.0	.0	.0	.0	1.0
S	.0	.0	4.4	4.6	.0	.0	.0	.0	9.1
SW	.0	1.0	1.4	3.8	.8	.0	.0	.0	7.1
W	.0	2.4	6.0	8.3	3.2	1.8	.0	.0	21.8
NW	.0	10.3	10.1	3.4	2.4	.0	.0	.0	26.4
IND	.0	.8	4.0	2.4	.0	.0	.0	.0	7.3
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.8	37.1	31.3	22.6	6.3	1.8	.0	.0	100.0

NUMBER OF OBS 124 IND=INDETERMINATE

APR — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	2.2	11.3	1.1	.0	.0	.0	.0	.0	14.6
NE	.4	23.2	.0	.0	.0	.0	.0	.0	23.6
E	1.6	22.2	.4	.0	.0	.0	.0	.0	24.2
SE	.1	6.2	.1	.0	.0	.0	.0	.0	6.3
S	.4	1.3	.0	.0	.0	.0	.0	.0	1.6
SW	.0	.1	.0	.0	.0	.0	.0	.0	.1
W	.0	2.0	.4	.8	.0	.0	.0	.0	2.3
NW	.0	15.1	6.1	.3	.3	.0	.0	.0	22.2
IND	.0	.9	.0	.0	.0	.0	.0	.0	.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.7	86.4	8.0	.3	.3	.0	.0	.0	100.0

NUMBER OF OBS 213 IND=INDETERMINATE

MAR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.8	8.9	4.0	.8	.0	.0	.0	.0	14.5
6-7	.0	14.5	9.7	11.3	.0	.0	.0	.0	35.5
8-9	.0	12.9	13.7	7.3	3.2	.0	.0	.0	37.1
10-11	.0	.0	.0	.8	1.6	.0	.0	.0	2.4
12-13	.0	.0	.0	.0	1.6	1.6	.0	.0	3.2
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.8	4.0	2.4	.0	.0	.0	.0	7.3
TOTAL	.8	37.1	31.3	22.6	6.3	1.6	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA	HR	IND=INDETERMINATE
124	6.0	12	280	SWL	26	08	(DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

APR — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	4.7	72.3	3.3	.0	.0	.0	.0	.0	80.3
6-7	.0	11.3	3.3	.0	.0	.0	.0	.0	14.6
8-9	.0	1.9	.9	.0	.0	.0	.0	.0	2.8
10-11	.0	.0	.5	.5	.5	.0	.0	.0	1.4
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.9	.0	.0	.0	.0	.0	.0	.9
TOTAL	4.7	86.4	8.0	.3	.3	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA	HR	IND=INDETERMINATE
213	4.0	10	300	SWL	03	00	(DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 9

Selected Gale Observations, North Pacific

March and April 1974

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC		MAR.															
SS GALVESTON	AMERICAN	4	57.3 N	145.1 W	12	30	60	5 NM	02	993.6	- 3.4	2.8			30	7	29.5
SS EXXON NEWARK	AMERICAN	4	52.0 N	140.9 W	12	25	42	5 NM	02	1005.8	3.0	3.0			28	< 6	21
SS ARCO PRUDHOE BAY	AMERICAN	5	52.4 N	133.8 W	06	29	48	2 NM	26	1006.4	2.2	3.4	9	31			
SS EXXON NEWARK	AMERICAN	5	53.3 N	143.4 W	12	32	50	5 NM	02	1017.3	0.5	4.4			31	>13	39
SS GALVESTON	AMERICAN	5	57.6 N	146.4 W	06	31	60	5 NM	02	1000.0	- 2.8	3.7			30	7	29.5
SS SANTA MARIA	AMERICAN	5	58.6 N	151.9 W	06	28	49	5 NM	02	1015.9	4.0	3.3	6	21			
SS PRES HARRISON	AMERICAN	5	36.9 N	158.3 E	18	30	45	10 NM	62	1003.5	8.9	12.2	5	14.5	30	7	24.5
SS PHILADELPHIA	AMERICAN	5	54.0 N	133.8 E	18	30	50	5 NM	15	1008.8	2.8	3.5	6	13	30	8	19.5
SS EXXON NEWARK	AMERICAN	6	55.8 N	148.8 W	12	31	50	5 NM	24	1018.6	2.0	3.3			30	7	26
SS PHILADELPHIA	AMERICAN	6	54.3 N	136.6 W	00	31	45	5 NM	26	1011.2	1.7	5.5	7	13	31	9	19.5
SS HAWAIIAN QUEEN	AMERICAN	7	35.8 N	128.3 W	06	36	41	10 NM	02	1007.5	8.9	18.3	5	10	36	10	14.5
SS SINCLAIR TEXAS	AMERICAN	7	48.2 N	135.6 W	12	33	50	10 NM	70	1017.3		4.2			33	< 6	14.5
SS PHIL MAIL	AMERICAN	7	36.2 N	175.4 E	06	28	45	10 NM	02	1015.2	12.7	15.0					
SS PRES HARRISON	AMERICAN	7	34.8 N	144.8 E	12	23	44	2 NM	64	1012.0	12.2	17.2	6	19.5			
MV HAVIS	NORWEGIAN	7	47.6 N	136.2 W	06	33	45	10 NM	26	1017.0	3.0	5.0		21	31	X	29.5
MV EASTERN OCEAN	LIBERIAN	7	48.7 N	161.8 W	06	11	H 41	1 NM	61	1006.2	5.8	7.0	8	10	11	13	19.5
SS EXXON NEWARK	AMERICAN	7	57.4 N	149.7 W	00	31	55	10 NM	88	1015.6	1.0	3.3			30	8	29.5
MV BEISHU MARU	JAPANESE	8	49.5 N	132.8 W	12	17	H 43	200 YD	63	980.6	4.3	8.1	5	10	14	7	8
SS J H TUTTLE	AMERICAN	8	54.0 N	152.0 W	12	32	45	2 NM	70	992.0	4.1	2.2	4	10	33	9	14.5
SS SANTA MARIA	AMERICAN	9	58.3 N	150.7 W	06	36	45	5 NM	02	984.4	0.5	4.4	5	13	36	13	19.5
SS POLAR ALASKA	LIBERIAN	9	55.6 N	158.0 W	12	36	H 45	2 NM		995.0	- 7.0	2.0	9	6.5			
SS SUMMIT	AMERICAN	9	54.5 N	152.4 W	06	01	65	10 NM	02	977.0	0.0	2.7			01	10	41
USCGC YOCONA	AMERICAN	9	47.8 N	129.2 W	00	18	50	5 NM	18	1005.6	4.4	7.8	6	16.5			
USCGC WINONA	AMERICAN	9	47.8 N	125.4 W	00	16	H 55	2 NM	61	1006.3	5.0	9.3	6	18			
SS AMER MAIL	AMERICAN	9	49.2 N	163.3 E	12	29	42	10 NM	87	1007.8	- 2.0	2.2	5	14.5	29	11	14.5
SS CHINA BEAR	AMERICAN	9	47.0 N	126.5 W	12	14	H 45	5 NM	07	1004.7	7.2	6.7	8	24.5			
SS J H TUTTLE	AMERICAN	9	56.9 N	151.9 W	18	35	45	2 NM	70	998.2	- 1.6	2.2	4	8	33	9	14.5
SS SUMMIT	AMERICAN	10	55.3 N	157.8 W	06	18	45	> 25 NM	02	1005.4	8.7	8.5			36	9	14.5
SS PRES TAYLOR	AMERICAN	10	35.4 N	144.0 E	06	18	46	.5 NM		994.2	19.2	17.7	7	32.5			
SS SEATRAIN LOUISIANA	AMERICAN	10	33.2 N	143.8 E	06	21	45	.5 NM	45	1000.0	15.6	17.2			21	6	19.5
MV TRANSOCEAN TRANSPORT	PHILIPPINE	10	38.8 N	171.1 E	18	34	N 43	10 NM	02	1016.4	5.0	13.9	7	19.5	34	>13	36
MV THEREN	NORWEGIAN	10	44.4 N	147.8 W	12	31	41	5 NM	36	1007.0	4.0	8.0	9	11.5			
SS WYOMING	AMERICAN	10	35.9 N	180.0 W	18	29	48	10 NM	02	1001.0	9.4	12.2			29	11	49
USCGC WINONA	AMERICAN	10	44.8 N	128.3 W	00	18	N 43	2 NM	61	1003.4	9.4	8.9	8	23			
SS AMER MAIL	AMERICAN	10	49.3 N	161.7 E	00	28	42	10 NM	88	1011.2	0.0	2.7	5	14.5			
SS J H TUTTLE	AMERICAN	10	57.7 N	151.8 W	00	35	45	5 NM	02	993.2	0.0	2.2	4	6.5	35	8	16.5
SS WYOMING	AMERICAN	11	35.3 N	178.0 E	06	33	48	10 NM	02	1013.2	8.9	13.3			33	11	49
SS AMER MAIL	AMERICAN	11	47.5 N	157.7 E	00	14	48	.5 NM	74	991.3	0.0	1.1					
SS PRUDENTIAL SEAJET	AMERICAN	12	43.1 N	124.7 W	18	22	50	5 NM	27	1004.5	4.4	8.9	6	13	22	12	13
SS PRES PIERCE	AMERICAN	16	36.1 N	171.2 E	18	28	H 45	10 NM	02	1004.5	11.2	19.0					
SS PRES PIERCE	AMERICAN	17	35.7 N	163.6 E	12	23	H 52	2 NM	02	992.2	15.0	19.6	9	26			
MV PLUTOS	GERMAN	18	41.7 N	150.2 W	12	13	43	5 NM	21	1011.0	11.0	10.0					
MV ROSE	LIBERIAN	20	31.5 N	164.0 E	18	27	H 41	2 NM	04	998.7	16.0	17.5					
SS RED JACKET	AMERICAN	21	37.8 N	175.0 E	12	21	50	5 NM	23	971.7	10.6	12.8			21	9	19.5
MV ROSE	LIBERIAN	21	31.1 N	179.1 E	12	30	H 42	2 NM	01	1008.0	19.8	17.0					
SS ZIM NEW YORK	GERMAN	21	34.7 N	176.6 W	21	27	55	2 NM	02	983.5	13.8	14.4		21	26	X	29.5
MV ZAMBOANGA	PHILIPPINE	21	34.5 N	180.0 E	12	33	H 42	2 NM	01	983.2	13.0	13.0			12	>13	19.5
MV BAY BRIDGE	SINGAPORE	21	33.2 N	179.6 W	18	26	H 45	5 NM	01	987.8	15.5	16.5	8	18	25	12	23
MV EASTERN BUILDER	LIBERIAN	21	37.1 N	179.8 W	18	24	H 42	2 NM	02		10.0	12.0	5	23	27	6	26
MV MARITIME ACE	PANAMANIAN	22	35.2 N	148.7 E	18	28	N 44	2 NM	05	1004.5	12.0	19.0	10	16.5	28	10	19.5
MV UNION EXPANSION	LIBERIAN	22	38.0 N	170.9 W	18	34	56	1 NM		967.0	11.0	13.0	3	16.5	24	11	41
MV ZAMBOANGA	PHILIPPINE	22	34.3 N	173.9 W	12	24	N 51	2 NM	03	992.1	12.0	16.0	8	16.5	24	>13	19.5
SS ZIM NEW YORK	GERMAN	22	34.7 N	176.9 W	06	27	63	5 NM	02	986.0	12.0	15.0	10	36			
SS GUAM BEAR	AMERICAN	22	31.4 N	150.5 W	18	25	50	.5 NM	84	999.7	18.3	18.3	6	10	18	6	8
MV EASTERN BUILDER	LIBERIAN	22	35.6 N	177.3 E	18	32	N 57	2 NM	29	997.5	9.0	13.0	7	16.5	32	7	19.5
MV JESPER MARSK	LIBERIAN	22	32.4 N	147.5 E	12	24	45	10 NM	02	1007.0	17.0	13.5	6	23			
MV HAKUSAN MARU	JAPANESE	22	31.9 N	172.1 W	18	28	H 48	2 NM	25	991.6	10.5	17.0	6	14.5	29	9	32.5
SS COLORADO	AMERICAN	22	29.4 N	172.3 W	18	30	42	5 NM	01	1001.8	13.6	17.2					
SS HAWAII BEAR	AMERICAN	22	28.8 N	171.3 W	18	28	54	5 NM	03	1001.7	14.4	16.9			28	X	41
MV SAMOAN REEFER	DANISH	22	28.9 N	167.3 E	00	31	47	10 NM	02	1013.2	19.0			23	32	7	32.5
MV PRINCE MARU # 7	JAPANESE	22	30.5 N	171.4 W	06	27	N 48	2 NM	60	996.5	13.5	14.0	9	16.5			
SS SEATRAIN GEORGIA	AMERICAN	22	32.0 N	151.5 W	06	14	50	.25 NM	65	999.0	18.3	17.2			XX	X	29.5
SS RED JACKET	AMERICAN	22	37.4 N	177.7 W	06	27	58	2 NM	25	988.0	10.6	12.2			27	>13	26
MV MARGARET CORD	DANISH	22	33.7 N	167.1 W	18	27	47	5 NM	23	998.7	14.5	15.5	12	26			
MV ZAMBOANGA	PHILIPPINE	23	34.1 N	170.7 W	00	24	N 51	2 NM	03	987.2	13.0	13.0	10	19.5	24	>13	19.5
SS WILLIAM M ALLEN	LIBERIAN	23	28.3 N	175.8 W	06	29	45	10 NM	01	1013.2	20.0	20.0	7	23			
SS ZIM NEW YORK	GERMAN	23	34.1 N	179.6 E	03	31	60	5 NM	13	1003.8	12.8	13.0	12	36			
SS WASHINGTON MAIL	AMERICAN	23	37.5 N	163.0 E	12	28	50	10 NM	02	991.8	11.1	13.9		24.5			
SS GOLDEN BEAR	AMERICAN	23	42.7 N	139.2 W	00	14	N 42	2 NM	84	984.8	9.4	7.2	2	8	14	7	29.5
SS MASON LYKES NEW	AMERICAN	23	30.8 N	165.5 W	18	28	50	5 NM	29	1002.2	14.4	17.3			28	7	32.5
SS HAWAII BEAR	AMERICAN	23	29.3 N	172.3 W	06	29	60	5 NM	02	1006.1	16.4	17.8			30	>13	49
MV HAKUSAN MARU	JAPANESE	23	31.6 N	173.3 W	18	27	N 50	2 NM	25	999.4	12.0	16.5	7	26	31	9	46
MV MARGARET CORD	DANISH	23	33.6 N	168.3 W	12	27	63	5 NM	17	991.7	12.0	13.0	14	46			
SS BIENVILLE	AMERICAN	23	37.2 N	168.5 E	18	23	45	10 NM	02	992.9	10.0	12.7	5	10	28	8	14.5
SS COLORADO	AMERICAN	23	29.2 N	173 5 W	06	29	42	2 NM	17	1006.5	16.6	18.3					
MV TOYUTA MARU # 10	JAPANESE	23	30.3 N	167.2 W	18	28	N 58	1 NM	07	1004.3	18.0	19.0	6	16.5	27	10	41
MV TURANDOT	NORWEGIAN	23	46.2 N	147.2 W	18	13	50	1 NM	04	986.0	10.0	7.0		23			
MV UNION EXPANSION	LIBERIAN	23	37.2 N	171.4 W	12	38	58	.25 NM		981.0	10.0	14.0					
SS RED JACKET	AMERICAN	23	37.9 N	179.6 E	00	30	60	2 NM	02	988.4	10.0	13.3	16	19.5	30	>13	41
SS SEATRAIN GEORGIA	AMERICAN	23	28.2 N	156.8 W	18	25	59	2 NM	02	1002.7	20.0	19.4			28	>13	26
SS WASHINGTON MAIL	AMERICAN	24	37.7 N	172.5 E	06	27	45	5 NM	18	991.0	10.6	13.9	6	11.5	29	10	41
MV ZAMBOANGA	PHILIPPINE	24	33.5 N	164.5 W	00	24	N 45	5 NM	03	998.2	16.0	16.0	4	19.5			
MV MARGARET CORD	DANISH	24	33.7 N	168.7 W	00	29	59	5 NM	09	1000.7	14.2	14.0	11	32.5			
SS MASON LYKES NEW	AMERICAN	24	30.7 N	165.8 W	00	27	45	10 NM	02	1008.0	19.4	17.3	9	10	27	7	36
SS BIENVILLE	AMERICAN	24	38.9 N	170.2 E	00	28	35	5 NM	02	995.6	11.6	11.6	5	19.5	28	6	29.5
MV EASTERN BUILDER	LIBERIAN	24	34.4 N	174.4 E	00	27	N 45	2 NM	04	1000.1	20.0		7	10	30	8	13
MV UNION EXPANSION	LIBERIAN	24	38.4 N	173.7 W	12	27	48	.5 NM		994.0	14.0	14.0					
SS RED JACKET	AMERICAN	24	37.2 N	178.9 E	18	28	65	10 NM	18	993.5	11.1	13.9			28	>13	29.5
MV TURANDOT	NORWEGIAN	24	46.3 N	148.2 W	00	17	50	1 NM	04	986.0	10.0	8.0		23			

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind			Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C		Sea Waves†		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°		Speed kt.				Air	Sea	Period sec.	Height ft.	Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		MAR.																
Ss SEATRAIN GEORGIA	AMERICAN	24	28.2 N	156.8 W	00	29	M	34	5	NM 16	1006.4	19.4	18.8	2	16.5	28	7	36
Ss WASHINGTON MAIL	AMERICAN	25	37.8 N	178.0 W	06	27		45	5	NM 14	994.2	11.1	13.3	6	11.5	25	>13	41
Ss ARCTIC TOKYO	AMERICAN	25	53.4 N	177.7 E	18	04	M	46	.5	NM 92	981.0	- 1.5	3.0	18	19.5			
Mv MARITIME ACE	PANAMANIAN	25	32.4 N	163.9 E	12	28	M	47	5	NM 02	1008.0	12.0	17.0			27	12	21
Ss BIENVILLE	AMERICAN	25	34.1 N	178.1 E	00	27		41	5	NM 02	1007.1	15.6	16.2	8	16.5	27	6	24.5
Ss HILLYER BROWN	AMERICAN	25	39.0 N	151.6 W	12	09		45	10	NM 02	1000.0	2.8	3.9	4	8			
Mv EASTERN BUILDER	LIBERIAN	25	34.0 N	172.5 E	00	27	M	45	10	NM 03	1000.7	20.0		8	13	32	8	13
Ss SANTA CLARA	AMERICAN	25	38.4 N	156.0 W	18	28		50	2	NM 97	992.6	11.2	12.8	XX	11.5	30	10	24.5
Mv UNION EXPANSION	LIBERIAN	25	34.7 N	175.1 W	00	27		49	1	NM	999.0	14.0	19.0	4	16.5	27	13	44
Ss THOMAS E CUFFE	AMERICAN	25	34.3 N	169.5 E	18	27	M	43	5	NM 25	997.3	10.6	11.1			27	7	10
Ss RED JACKET	AMERICAN	25	37.2 N	175.5 E	00	28		65	10	NM 02	997.3	16.1	12.2			28	>13	29.5
Mv QUEENS WAY BRIDGE	JAPANESE	26	39.2 N	165.1 W	12	26	M	52	5	NM 02	988.3	12.0	12.0			26	9	10
Mv UNION EXPANSION	LIBERIAN	26	34.2 N	177.8 W	06	26		62	2	NM 02	998.5	14.0	1.7	3	16.5	28	13	32.5
Ss AMER LARK	AMERICAN	27	30.9 N	145.3 W	00	23	M	44	1	NM 12	998.6	14.5	16.8			25	8	19.5
Ss PHIL MAIL	AMERICAN	27	36.0 N	148.0 E	18	08		55	5	NM 62	994.9	10.0	16.7	10	19.5			
Mv EASTERN BUILDER	LIBERIAN	28	33.3 N	160.5 E	00	23	M	45	2	NM 58	1000.8	18.0		8	13	35	8	13
Mv JAPAN ACE	JAPANESE	28	39.2 N	174.1 W	12	27	M	45	5	NM 28	999.5	9.0	10.0	9	14.5	27	11	29.5
Ss KOREAN MAIL	AMERICAN	28	38.0 N	154.9 E	00	09		60	2	NM 51	999.7	7.2	12.8			09	6	26
Ss PHIL MAIL	AMERICAN	28	35.8 N	151.1 E	06	33		60	2	NM 62	991.5	10.6	13.9	10	19.5	23	10	19.5
Ss PRES HARRISON	AMERICAN	29	35.6 N	171.0 E	06	26	M	45	5	NM 02	1000.2	14.4	13.3	6	16.5	27	7	24.5
Ss KOREAN MAIL	AMERICAN	29	39.4 N	162.8 E	00	31		60	2	NM 01	988.5	6.7	10.6			31	6	24.5
Mv MOSBAY	NORWEGIAN	30	42.9 N	165.5 W	18	25	M	43	10	NM 01	988.8	9.0	11.0		8	23	X	16.5
Ss WASHINGTON MAIL	AMERICAN	30	36.5 N	127.5 W	00	19		60	2	NM 63	1006.5	15.0	13.3	5	8	27	10	5
NORTH PACIFIC		APR.																
Mv LICA MAERSK	DANISH	1	33.3 N	150.6 E	12	17		45	2	NM 02	1012.6	15.8	14.0					
Ss ELIZABETH LYKES /NEW/	AMERICAN	1	30.7 N	127.0 E	00	31	M	42	10	NM 02	1017.1	11.5	13.0	6	11.5	31	7	14.5
Mv CHRYSANTEMA	BRITISH	2	37.5 N	160.1 E	18	19		50	1	NM 07	1004.5	15.0		4	16.5	25	>13	32.5
Mv UNION SUNRISE	CHINESE	4	33.5 N	157.5 W	06	34	M	45	10	NM 01	1022.5	14.0	15.0					
Ss SUMMIT	AMERICAN	4	58.6 N	150.2 W	18	05		45	5	NM 02	1004.8	3.3	3.3	6	10			
Mv HIEI MARU	JAPANESE	4	37.2 N	147.3 W	12	34	M	52	1	NM 81	997.0	11.0	14.0	5	6.5	31	8	13
Ss CALIFORNIAN	AMERICAN	5	43.3 N	131.1 W	06	17		45	5	NM 01	994.8	10.0	11.6	5	14.5	17	7	19.5
Ss PHIL MAIL	AMERICAN	5	36.3 N	130.6 W	00	16		48	5	NM 03	1011.9	16.7	14.4					
Mv VAN WARRIOR	LIBERIAN	6	44.3 N	151.3 E	18	28		45	2	NM 07	998.0	2.0	2.0					
Ss PRES MCKINLEY (NEW)	AMERICAN	6	47.4 N	151.2 W	00	32		43	5	NM 02	997.0	6.1	7.2	6	11.5	31	9	14.5
Mv MONTIRON	LIBERIAN	6	48.3 N	132.0 W	00	26	M	45	5	NM 02	999.5	8.0	0.6	12	13			
Ss ARCTIC TOKYO	LIBERIAN	7	44.0 N	151.5 E	06	32	M	41	2	NM 68	1010.0	1.0	3.0	12	13			
Mv QUEENS WAY BRIDGE	JAPANESE	8	39.7 N	164.6 W	18	21	M	44	1	NM 63	1011.5	13.0	12.0			21	7	10
Mv EASTERN CHERRY	LIBERIAN	8	41.5 N	174.8 E	06	28		45	10	NM 03	1001.0	10.0	8.0	11	19.5	23	10	18
Mv BELLA MAERSK	DANISH	8	42.3 N	140.4 W	06	28		42	2	NM 62	1004.6	7.5			19.5			
USNS SUAMICO	AMERICAN	12	49.3 N	168.2 E	00	13		50	.25	NM	999.7	4.4	0.0	6	11.5			
Mv WOERMANN SASSANDRA	SINGAPORE	12	45.5 N	158.4 W	12	32		41	5	NM 60	1001.0	4.5	6.0	7	11.5	06	6	10
Mv GRAND GLOBE	LIBERIAN	14	14.8 N	170.8 W	00	27	M	42	2	NM 08	1009.0	8.7	11.0	6	9	27	>13	10
Mv LIECHTENSTEIN	LIBERIAN	15	47.8 N	160.8 E	18	20	M	42	2	NM 02	984.0	3.0	3.9	9	14.5	20	10	18
Mv VAN TRIUMPH	LIBERIAN	16	43.5 N	161.0 E	00	28	M	41	5	NM 02	1010.0	8.0	6.0					
Mv LIECHTENSTEIN	LIBERIAN	16	47.5 N	165.5 E	00	28	M	42	5	NM 01	990.5	3.0	3.3	9	14.5	27	11	19.5
MV VAN TRIUMPH	LIBERIAN	21	51.3 N	145.8 W	18	29	M	41	5	NM 02	1009.0	4.0	3.0					
Ss TRANSONYX	PANAMANIAN	21	35.8 N	145.2 E	12	16		45	2	NM 03	1014.5	18.0	18.0					
Ss TRANSONYX	PANAMANIAN	22	35.8 N	147.9 E	00	18		45	2	NM 18	1013.5	17.5	19.0					
MV VAN TRIUMPH	LIBERIAN	22	51.0 N	143.2 W	00	10	M	45	5	NM 05	1009.5	7.0	6.0					
Ss RED JACKET	AMERICAN	22	41.2 N	149.2 E	00	14		45	5	NM 00	1010.5	6.7	3.3			14	6	14.5
Ss PRES PIERCE	AMERICAN	22	41.4 N	168.2 E	06	32	M	45	10	NM 02	1017.5	9.4	6.7	10	18			
Ss WALTER RICE	AMERICAN	25	15.9 N	93.2 W	18	36		50	10	NM 02	1012.9	28.8	27.7	2	6.5			
MV EASTERN BUILDER	LIBERIAN	26	46.7 N	162.1 W	00	20	M	44	2	NM 50	985.0	8.0	8.0	5	6.5	16	< 6	14.5
Ss PRES TAFT /NEW/	AMERICAN	26	47.8 N	159.8 W	00	15		45	2	NM 61	992.2	6.7	3.9	5	8	17	7	16.5
Ss THOMAS JEFFERSON	AMERICAN	28	28.5 N	130.3 E	06	20		50	1	NM	1001.0	21.7	23.3	5	14.5			
MV WAY WAY	LIBERIAN	29	49.8 N	173.8 W	06	09	M	43	1	NM 50	1000.6	4.3	- 0.5	8	6.5			
Ss JAPAN BEAR	AMERICAN	29	45.6 N	169.3 W	18	15	M	46	2	NM 51	1004.0	7.2	6.1	9	13	18	12	13
Mv HIEI MARU	JAPANESE	29	43.0 N	174.1 W	12	18	M	41	1	NM 62	996.5	11.0	9.5	4	6.5	20	9	16.5

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Rough Log, North Atlantic Weather

June and July 1974

ROUGH LOG, JUNE 1974--There was no such thing as a primary storm track this month. The numbers of cyclone centers were below normal and their paths were confused. According to climatology there is a primary track across southern Canada which splits near James Bay, one branch continues eastward, while the other curves northeastward into Baffin Bay. Another track is across the Great Lakes and is joined by another from off the northeast U.S. Coast. This then extends east-northeastward to the south of Iceland into the Norwegian Sea. A second one, over water, starts south of Newfoundland and parallels the other, about 8° latitude to the south, into the Sheltand Islands. The major similarity this month was an overall easterly trend.

The mean pressure pattern conformed closer with climatology. The Azores High was normally located near 33°N, 38°W at 1022 mb rather than 1023.8 mb. The Icelandic Low was misplaced, near 55°N, 43°W, at 1010 mb rather than over the Labrador coast, near 57°N, 60°W, at 1010.5 mb. It also had another 1008-mb center over Keflavik, Iceland.

The mean departures from normal were small, 4-mb being the largest. A negative 4-mb anomaly was centered over Iceland with a corresponding positive 4-mb anomaly off the Labrador coast. A negative 3-mb anomaly stood out over Cape Hatteras. There was also a negative 3-mb center in midocean near 39°N, 38°W. An elongated 2-mb isoline with a 3-mb center paralleled the northwest African coast.

The upper air pattern followed its climatological pattern rather closely, with two exceptions. The major Low was further south over Hudson Bay rather than upper Baffin Bay. This was reflected by a trough generally paralleling the Mississippi River. The other was a reflection of the surface Low over Iceland, again at a lower pressure than the primary climatological one. The anomalies closely matched the surface in both location and sign.

Normally one tropical storm will occur every 2 yr and one of these will develop to hurricane strength every 4 yr. None occurred this month.

Not only were there fewer LOWS than normal, they were weak. The pressures were not deep nor were the winds strong. This is normally expected in the summer months but not this early.

The first storm of the month tracked out of the northern plains and was east of James Bay on the 1st, at 988 mb. Early on the 2d, it moved over the water of the Labrador Sea. The JOHN CABOT, near the Virgin Rocks of the Grand Banks, was hit by 35-kt winds. Far to the south between the front and a small HIGH, the GOLDEN GATE found 40-kt gales.

The LOW was south of Kap Farvel, by 1200 on the 3d, and in the meantime a small 1003-mb LOW developed and dissipated in a short time, near 51°N, 47°W. The ALBRIGHT PIONEER was just south of the center and was pounded by 40-kt gales and 12-ft swells. On the 4th, the LOW turned northeastward and, on the 5th, eastward. On the 7th, it brushed the Norwegian coast and turned northward to dissipate over Spitsbergen on the 10th.

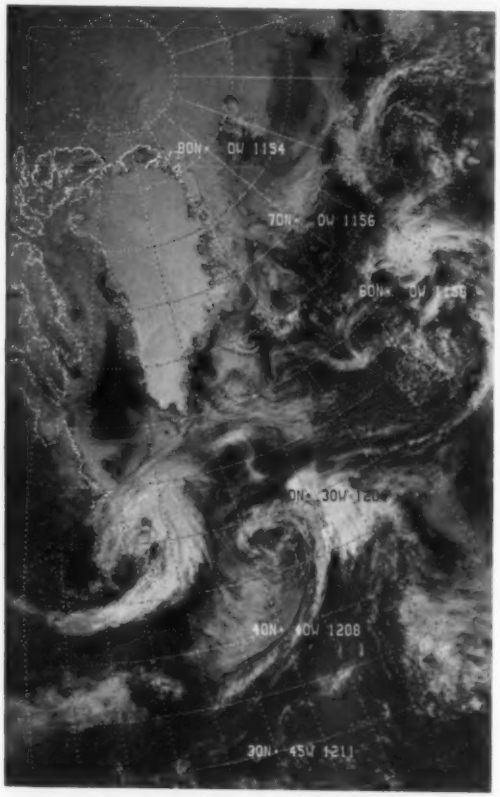


Figure 31.--A few hours later, the two LOWs have both moved further east. The winds were not as high as might be expected.

This storm formed west of Lake Winnepeg on the 3d. It traveled due east and was still a weak wave on a front on the 5th. As it crossed the Strait of Belle Isle, early on the 6th, another LOW was moving northeastward and was about 500 mi east of St. John's. The QUEENSGARTH was plowing into 40-kt gales north of this center (fig. 31).

The drilling rig VGBZ on Sable Island Bank measured 40-kt winds. When the storm center moved over water it deepened to 994 mb, at 1200 on the 6th, and slowed in its easterly movement. On the 7th, GENE TREFETHEN in Cabot Strait reported 35-kt gales

out of the north and the SIR HUMPHREY GILBERT in Notre Dame Bay tended to be pushed toward shore by 40-kt winds.

Twelve hours later the GILBERT was still being blown by 35-kt gales and the same wind speed band had moved over SEDCO I. The LOW was almost stalled now, east of Newfoundland, and filling. On the 9th, the storm was only an area of general low pressure with several odd centers.

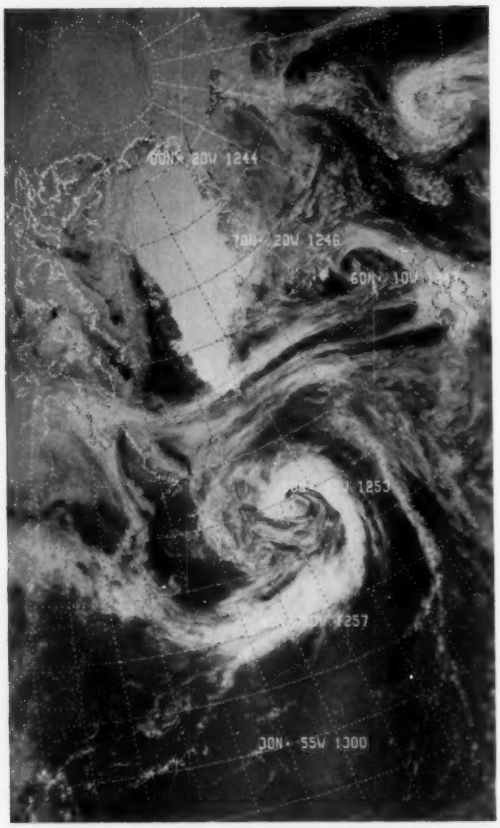


Figure 32.--This satellite image places the LOW within a few miles of the surface analysis position. Only the southwestern ocean has clear to scattered skies.

This was one of the LOW's, in the general area of low pressure, over the Gulf of St. Lawrence from the previous system. At 1200 on the 9th, it hit VGBZ with 40-kt gales. The upper-air LOW was north of Newfoundland and the surface LOW raced around its southern periphery. At 1200 on the 10th, it was at 50°N, 43°W (fig. 32). The NEW ENGLAND TRAPPER, at 44°N, 43°W felt the sting of 35-kt gales. On the 11th, the UPJD, ahead of the cold front found 40-kt winds with 13-ft seas and 13-ft swells. By 1200 that day, the storm's central pressure had dropped to 980 mb near 54°N, 39°W. A ship which appeared to be the GONO was at 53°N, 30°W, and reported 40-kt southerly winds with 16-ft seas and 20-ft swells. To the south and along the front, the ERLANGEN and the MUENCHEN both were battered by 35-kt gales with seas and swells under 15 ft.

As happens many times, when the LOW moved toward the Denmark Strait another center developed south of the main one. Over the colder waters the old center weakened but continued moving northward and was last seen passing near Spitsbergen.

This 1007-mb wave formed on a front near 50°N, 24°W. It moved north-northeastward and, at 0000 on the 20th, was near 56°N, 17°W. The GAMNAGAS, at 46°N, 35°W, was being pushed by 35-kt gales on her port side. On the other side of the LOW the WCHU was sailing with 40-kt winds on her port side. On the 21st, the rapidly weakening LOW passed east of Iceland and disappeared.

A front moved southward across the midwest and, on the 24th, paralleled the Gulf coast. At 1200 on the 24th, a wave formed near the Florida-Georgia border. Without intermediate detailed charts it cannot be determined if it remained almost stationary or moved eastward, dissipated, and a new one formed. A tropical depression was in the Bay of Campeche and combined with the frontal wave produced high tides and surf on the Florida west coast. Wind gusts over 50 kt were measured near St. Petersburg.

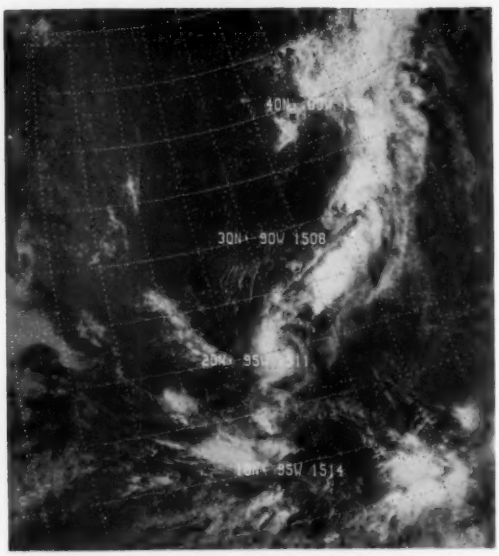


Figure 33.--The bright return, near 20°N, 90°W, is the tropical depression, and the larger bright area to the northeast is the beginning of the wave. The other wave near Charleston can also be seen.

At 1200 on the 25th, a wave was over central Florida with the beginnings of a circulation (fig. 33). Out at sea

in the southerly flow, the ZIM NEW YORK encountered rain showers and 35-kt winds. As the wave moved northeastward, up the northeast-southwest oriented front, off the coast, the CORONADO fought the highest wind for the North Atlantic this month. At 0000 on the 26th, a second wave was off Charleston, S.C., the CORONADO was near 32°N, 73.5°W, and was being pushed by 50-kt storm winds from the southwest on her northerly track. She reported both 16-ft seas and 16-ft swells. There were three other gale-force reports, all on the warm side of the front. They were the SEA-LAND VENTURE, USCGC UNIMAK, and the LNML.

As the wave rolled up the front the drilling rig VC8062 was washed by heavy rain and 40-kt winds at 1200. By 0000 on the 27th, the apex of the wave was about 300 mi south of Argentia and ready to give up the fight. It could not develop the closed circulation that is needed for long life.

This storm started out as a weak tropical depression on the 22d, in the Bahia de Campeche. The depression never developed into anything more than a cloud mass but was closely watched by the National Hurricane Center. Winds of 30-kt were reported. On the 26th, a front moved far enough south to be pulled into the circulation, and the system changed to extratropical, At that time it started moving northward, and crossed into Florida early on the 27th. Tides were up to 3 ft above normal and heavy rains occurred, with over 10 in in 30 hr being measured near Tampa. Tornadoes also broke out over the state.

At 0600 on the 28th, the 1010-mb LOW was over Cape Hatteras. The GYPSUM PRINCE was off Cape May and had 40-kt gales from the east-northeast. A HIGH was pushing south and southeastward out of Canada across New England. This forced the LOW inland over Delaware Bay. Heavy rains had occurred over the coastal regions of North Carolina and Virginia. Gale warnings were posted along that section of the shore.

By 1200 on the 29th, only the frontal system and a trough remained as the HIGH continued to push southeastward.

Casualties--The Danish WIVI BEWA (1,399 tons) was delayed by ice and sustained leakage in the forepeak. Vessel was due Stephenville on the 26th. The German motorvessel HOHEWEG (724 tons) was taken in tow by the ELKE KAHRS, about 70 mi from Bilbao, and returned to Bilbao, on the 23d, with a slight list due to heavy weather. The 12,387-ton Greek tanker KANARIS went aground in the Orinoco River at mile 12 during a rainstorm. Assistance was called for after initial attempts to refloat were unsuccessful.

ROUGH LOG, JULY 1974--This was a quiet month. There were no tropical cyclones and the majority of the extratropical cyclones were weak and shortlived. The total storm track pattern was shifted eastward of the climatological pattern. The most concentrated area was south and east of Nova Scotia and Newfoundland, between 35° to 50°N and 45° to 65°W. These were mainly frontal waves moving northeastward. The storm tracks in the northeastern Atlantic were spaced from the east coast of Greenland to across Scotland.

The overall sea-level pressure pattern matched climatology in the major features. The most prominent of these was the Bermuda-Azores High. It was centered near 40°N, 30°W at 1027 mb, or about 750 mi northeast of its mean position of 35°N, 44°W at 1024.6 mb. The climatic 1008.6-mb Low over Hudson Strait was matched by a 1009-mb Low. A significant difference in the pattern was a 1002-mb Low off Vestfjorden, Norway.

A minor perturbation in the pressure pattern had a major effect on the weather affecting shipping. This was a low-pressure trough that indented the Bermuda High. It extended southward from the Bay of Fundy and was associated with the frontal waves that traversed that area off the coast.

The largest anomaly was a minus 8-mb centered with the Low off the coast of Norway. The next largest was a positive 6-mb near Cape Finisterre. This positive area encompassed the area east of 40°W between 30°N and 50°N and extended into southern Europe, the Mediterranean, and North Africa. A negative 3-mb anomaly was centered near 40°N, 60°W. This was associated with the trough off the coast. Northern Greenland, Baffin Bay, the Labrador Sea, and the northern islands of Canada were an area of higher than normal pressure. As a matter of interest a negative 7-mb anomaly was centered near the North Pole.

The mean upper-air chart was near normal. The surface trough off the east coast of North America was reflected at 700 mb as was the Low over the Norwegian Sea.

The North Atlantic was no Titan this month. There was only one storm in which the winds reached 50 kt. Due to this, isolated wind reports will be mentioned without discussing the complete life of the system. At 0000 on the 2d, a cold front had moved over Nova Scotia and was approaching the drilling rig VGBZ, which reported 40-kt southwesterly winds.

This was the storm with the highest winds for the month. On the 3d, a closed cyclonic circulation was analyzed near Anticosti Island in the Gulf of St. Lawrence. A weak east-west frontal system stretched from the Great Lakes to Ireland. Small waves were rippling along this front. At 0000 on the 4th, SEDCO I reported 35-kt winds as a frontal wave moved eastward.

As the LOW moved over water it started to deepen and, at 1200 on the 4th, was 989 mb and expanding its circulation. The TOPSDALSFJORD was near 49°N, 49.5°W with 35-kt gales, early on the 5th. By 1200 the LOW was 986 mb and had expanded north to Kap Farvel and south to 35°N. The drilling ship HAVDRILL, near 49.5°N, 51°W, had 40-kt winds and 21-ft seas from the northwest. The LABRADOR, north of Notre Dame Bay, and the TRADER, at 41.2°N, 49°W, reported 35-kt gales.

The LOW was moving eastward very slowly along 50°N and still deepening. At 0000 on the 6th, the pressure was 978 mb near 49.7°N, 42°W. The EVPW just out of Trinity Bay was pounded by 50-kt winds. Only a few miles to the east the HAVDRILL radioed 45-kt gales and 25-ft seas.

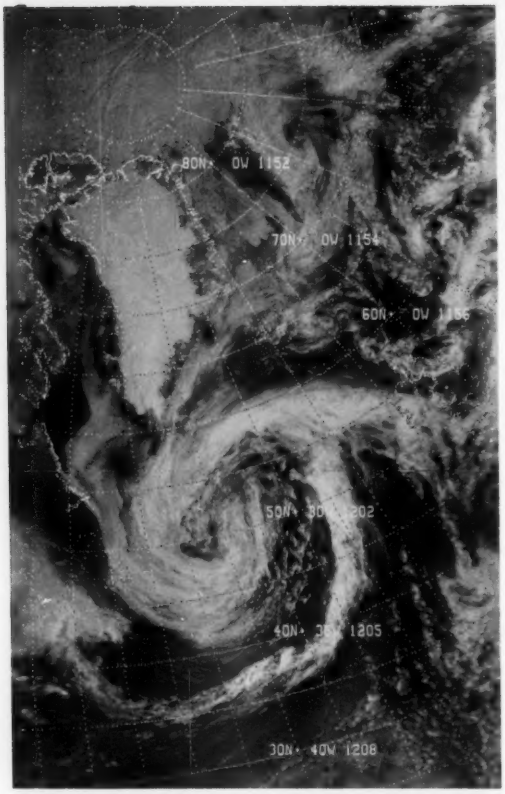


Figure 34.--For a summer storm this one covers a large area. It also generated the highest winds this month.

At 1200 on the 6th (fig. 34) another 50-kt wind was reported. The previous report was west of the center while this report from the WESER EXPRESS near 45°N, 38°W, was almost 300 mi due south of the center. She also reported 12-ft seas and 21-ft swells. The AMERICAN LEGEND was at 42.8°N, 42.3°W with 40-kt winds, 12-ft seas and 30-ft swells. The direction of the swell in both cases was from 250°. Winds of 35 kt were still being reported west of the center to the coast of Newfoundland. There had been no reports in the northern quadrant of the storm except Kap Farvel which was reporting 25 to 35 kt.

On the 7th, there were reports of 35- and 40-kt gales south of the center, and the central pressure started rising as the storm turned northeastward. On the 8th, the strongest wind band appeared to have shifted to the southeastern and eastern quadrants. The NOVOMOSKOVSK reported 35-kt gales ahead of the front, near 48°N, 13°W. On the 10th, the LOW dissipated as the main circulation moved north of Scotland with a LOW that moved around the edge of this storm.

As the previous storm moved northeastward a small HIGH moved south-southeastward out of Labrador. The Bermuda HIGH was elongated east-west, with the appearance of a banana. Between the two HIGH's there was a similar shaped LOW. A center was apparent, at 1800 on the 8th, near 38°N, 61°W. It pushed southeastward as the Bermuda center moved westward. At 0000 on the 10th, the pressure was 1005 mb near 37°N, 53°W. The LASH ESPANA was near 40°N, 55°W and the CETRA COLUMBA was near 42.5°N, 45°W, both reporting 35-kt gales. The LOW had turned northeastward as it pushed against the Azores HIGH, and by 1200 on the 11th, it was absorbed by the circulation of a LOW moving up the St. Lawrence River valley.

These wind and wave reports are the consequences of two HIGHs rather than a LOW. The meteorological processes that led up to this condition started several days before.

A multiple cell HIGH combined into one at 1032 mb pressure, on the 15th, near 40°N, 35°W. It basically remained stationary in that area fluctuating slightly in pressure. At that time, a LOW moved out of Canada into Baffin Bay and the front moved off the U.S. east coast. Another HIGH from central Canada was pushing southeastward and building.

On the 17th, the two HIGHs were squeezing the front as it lay about 300 mi off the coast and frontal waves were rippling northeastward along it (fig. 35).

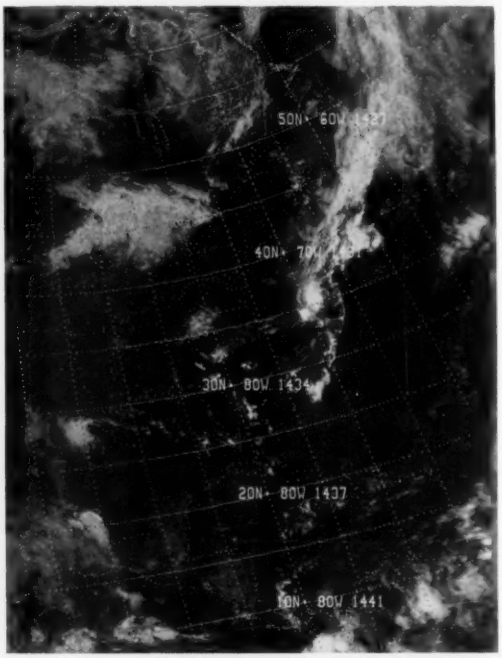


Figure 35.--The clear areas on both sides of the narrow frontal cloud band reflect the fair weather HIGHs. The conditions associated with the frontal waves were anything but fair.

At 0000 on the 18th, one of these small waves (1014 mb) was near Cape Race. The Azores HIGH was 1035 mb near 43°N, 30°W. The Canadian HIGH at 1025 mb was centered over the Pennsylvania-New York border. Behind the front, near 41°N, 58.5°W, the ship plotted as EIOW reported 45-kt gales from the southwest. It also reported, or at least the plot indicated, swell code 55 (27.5 m/90 ft) from 250°. On the other side of the front, the HAHNENTOR's plot near 40°N, 54°W, indicated swell code 35 (17.5 m/57 ft) with only 20-kt winds. At 1200 the UHSP, near 43°N, 63°W, reported (data plotted-30020) 33-ft seas with a 5-kt wind, probably a swell report from 300° with a 10-sec period. These high wave reports are hard to believe with the meteorological situation but there are too many to ignore. It was at 2000 that the EXPORT ADVENTURER encountered the sharp deep LOW at 39.6°N, 55.9°W. See Letter to the Editor, page 322. Far to the north on top of the HIGH, the UIZB was buffeted by 45-kt gales. This report was plotted with only 2-ft seas and no swell, at 0000 on the 18th.

Late on the 18th, one of the waves redeveloped or another developed near 57.5°N, 35°W. By 1200 on the 19th, it was a 990-mb tightly wound storm near 61°N, 26°W. The DRESDEN was at 57°N, 24°W, and caught in 40-kt gales. The LOW then moved south of Iceland and into the Norwegian Sea.

This LOW was born over Montana on the 15th. It moved over James Bay, on the 18th, and was over Nova Scotia on the 20th. At 0000 a ship reported a thunderstorm near Cape Sable and another ship off Cape Breton Island reported 40-kt winds. At 1200, the LASH TURKIYE, near 39.5°N, 61°W, was lashed by 40-kt southerly winds, 8-ft seas, and 12-ft swells. The 1001-mb LOW moved northeastward toward Newfoundland, and at 0000 on the 21st, SEDCO I measured 35-kt gales. The next report 24 hr later was still 35 kt, but the LOW was rapidly weakening and, by 1200 on the 22d, a small HIGH was over the area.

The HIGH north of the Azores persisted in the vicinity of 40°N, 30°W, until the 28th, with pressures as high as 1037 mb. At that time it started to break down and move south of the Azores.

Casualties--The 91,084-ton British bulk and oil carrier TYNE BRIDGE arrived at Seven Islands, on the 9th, with ice damage to the bulbous bow. The Liberian oil tanker ASIATIC (70,482 tons) was ripped by an explosion near Brest, France, and limped toward that port through 20-ft seas. The British submarine OPPORTUNE took off the injured and four passengers.

Rough Log, North Pacific Weather

June and July 1974

ROUGH LOG, JUNE 1974--There were relatively few extratropical cyclones over the Pacific this month. Many were short-lived. The storm tracks approximated the climatological mean paths in general but wandered and looped about this mean. The primary path extends from southern Japan to the Gulf of Alaska. A secondary track across Sakhalin Island into the southern Bering Sea and Alaska was not present. A new feature this month is a secondary storm track across northern Siberia and Alaska. As far as this month is concerned, it would be considered a primary track as there were more cyclones concentrated along a narrower path than elsewhere in the North Pacific. These should probably be considered Arctic Ocean rather than North Pacific storms.

The sea-level pressure pattern in the eastern North Pacific was near normal, and dominated by the Pacific High, centered near 35°N, 145°W, at 1025 mb. A sharper than normal trough in the Gulf of Alaska pushed southward into the High. The heat Low over the southwestern United States was well entrenched, 3 mb lower than the normal 1009-mb pressure. In the western half the gradient was very flat. There was a closed 1011-mb Low, near 42°N, 167°E, and a closed 1017-mb High over the Bering Sea. Normally there is an east-west oriented trough over the Bering Sea.

The anomaly pattern was complex, with many small centers. The trough in the Gulf of Alaska produced a minus 3 mb. The largest negative anomaly was minus 4 mb centered near 35°N, 170°E. A positive anomaly up to 4 mb was situated off the U.S. west coast. There was also a plus 6-mb center over the Bering Sea and a plus 5-mb center over the Sea of Okhotsk.

There were several variations from climatology in the upper air. The climatological normal shows a Low over the Bering Sea near 60°N, 175°E, and an elongated High with two centers straddling 25°N. This month there were three misplaced Lows; one over Manchuria, a small center near 47°N, 170°E, and a closed center over the Gulf of Alaska. An odd ball High was centered over the Sea of Okhotsk. All four of these misplaced centers were reflected by large anomalies--168 to 195 ft in the height of the 700-mb pressure surface.

The Pacific hosted seven tropical cyclones; two hurricanes and one tropical storm in the east, and two typhoons and two tropical storms in the west. They were: Blanca, Connie, and Dolores; and Dinah, Emma, Freda and Gilda respectively.

A front out of a LOW over Manchuria moved across Japan on the last day of May. On the 1st, a 993-mb LOW formed at the triple point of the occlusion, near 41°N, 146°E. The old LOW remained with the upper-air LOW while the new one was under the influence of the upper-air zonal flow and raced eastward. By 1200 on the 2d, it was 986 mb at 39°N, 174°E. The ALEKSANDER VERMISKEV, just south of the center at 37.5°N, was obscured by drizzle driven by 40-kt winds. front the OSTROGOZHSK had 35-kt easterlies and drizzle with 20-ft seas.

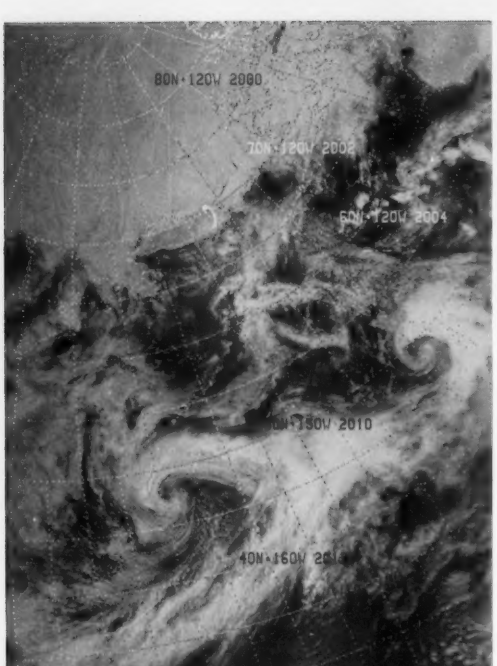


Figure 36. --This satellite picture, late on the 3d, shows the storm centered near 48°N, 169°W.

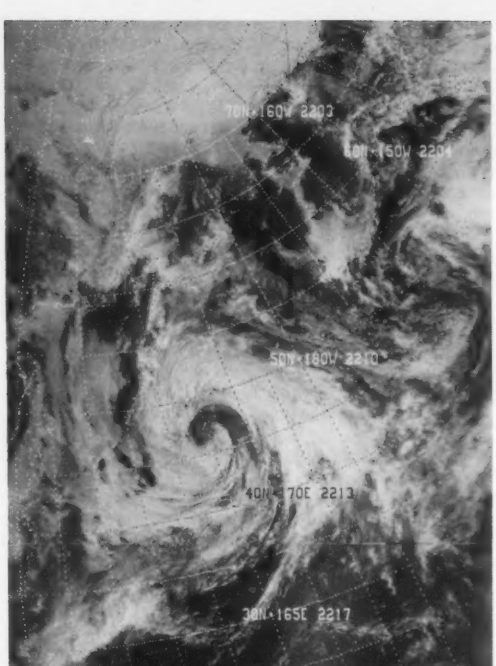


Figure 37. --This satellite photograph, at 2212 on the 8th, indicates the center of the storm was about 3° further west than the analysis indicated.

On the 3d, the storm turned northeastward and, by the 4th (fig. 36) was at 49°N, 166°W at 970 mb. The SHINYO MARU, near 44.5°N, 166°W, and THE LAUREL, near 47.5°N, 174°W, both suffered 45-kt gales. The SHINYO also reported 13-ft seas and 26-ft swells. The TRANSINDIANA, to the southeast of the center near 47°N, 162°W, contended with 40-kt winds and no seas plotted.

On the 5th, there were no significant winds reported but, early on the 6th, the SIBIR, south of the 990-mb center, near 49°N, 140°W, was hammered by 40-kt gales. A few hours after 1200 on the 6th, the storm disintegrated on the shore of British Columbia.

This was a slow developing storm. The first indication was a small closed LOW over interior China at 1200 on the 1st. It moved slowly east and southeastward, developing a front, on the 2d, as it moved over the Yellow Sea. Movement was very slow with little development of circulation until it turned northward on the 5th and 6th.

Late on the 6th, the center made an abrupt change to an easterly direction. Over the confluence of the Kuroshio and Oyashio Currents the storm intensified. The LIECHTENSTEIN, near the frontal triple point at 39°N, 156°E found 35-kt southeasterlies with 16-ft seas and 13-ft swells, at 0000 on the 7th. Later on the 7th and 8th the GOLDEN ARROW and the SHIKISHIMA MARU were bounced by 35-kt gales. The MINETAMA MARU, near 40°N, 167°E, was rolled by 40-kt winds on her port side. Again these were near the frontal triple point in the warm sector. She reported 13-ft swells.

On the 9th (fig. 37), the 982-mb storm was near 47.5°N, 162°E. The SHIKISHIMA MARU, still in the same general area east of the southern tip of the Kamchatka Peninsula, received 40-kt northerly winds with 12-ft seas and 15-ft swells. At 1200, the 7KTK at 47.2°N, 159.2°E also had 40-kt gales with the waves running 13 and 16 ft. The center was moving very slowly now and had filled to 994 mb by 0000 on the 10th. The TRANSOCEAN TRANSPORT was sailing southward, near 50°N, 177°E, with 35-kt southeasterlies. The waves in the area had built to 25-ft seas and 25-ft swells.

The LOW was pushing against a stubborn HIGH which was drifting eastward very slowly. By 1200 on the 13th, the LOW had worn away and disappeared from the charts.

The Pacific HIGH was firmly entrenched off the California Coast and a heat LOW was centered over the

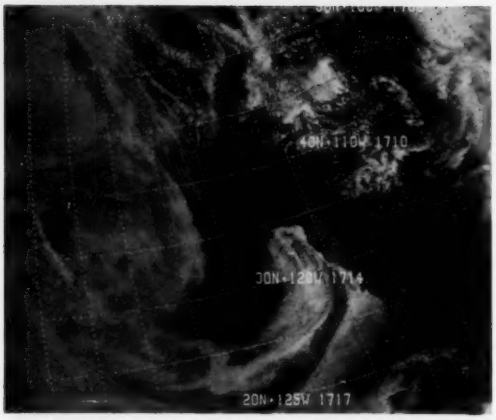


Figure 38.--The circulation around the HIGH can be inferred from the clouds, except off the California coast where the dry air and high winds were located.

California-Arizona border. Winds had been blowing up to 25 and 30 kt off the coast. Late on the 6th, the HIGH intensified very slightly and the pressure of the LOW dropped 5 mb to 997 mb by 1200 on the 7th (fig. 38). At that time, the EWUZ reported 45-kt gales, just off San Francisco. The HAWAIIAN QUEEN and the MONTANA, both further off the coast, both reported 35-kt winds. On the 8th, the TOYOTA MARU No. 12 was moving south, near 36.5°N, 126°W, with 35-kt northerly winds and 16-ft swells. Later that day, the LOW started moving eastward relaxing the gradient and decreasing the wind speed.

On the 8th, the North Pacific east of 180° was dominated by three high-pressure cells. An old weak front stretched westward from northern California. Late on the 8th, a wave formed on the front between two of the HIGHs. It quickly developed to a tight 1008-mb circulation. The LOW center crossed directly over Ocean Station Vessel "P" just prior to 0900 on the 9th. At 0900 "P" was hit by 40-kt northwest winds. At 1200, they were 30 kt. To the south, near 52.5°N, 140°W, the J. H. TUTTLE had 35-kt gales. Twelve hours later, she was still on the receiving end of 35-kt winds. On the 11th, the LOW was approaching Alaska's southeast coast and by the 12th had disappeared.

On the 0000 chart of the 13th, a frontal wave was analyzed just off the China Coast in the East China Sea. It moved rapidly eastward under the upper-air zonal flow with no intensification, until the 15th. By 1200, it was at 38°N, 155°E and 992-mb pressure. The PRAG, at 34°N, 155°E, experienced 35-kt gales just prior to frontal passage. At 0000 on the 16th, the TAMA MARU was being overtaken by the LOW, which passed southeast of their track, and was washed by 40-kt gales.

At 1200 on the 16th, the LOW was 992 mb at 41°N, 162°E. The PITTSBURGH was about 120 mi south of the center, and the SAGANOSEKI MARU was about 300 mi north of the center. Both had 40-kt winds and neither reported sea conditions. Both ships were traveling eastward and 12 hr later both reported 35-kt gales. The PITTSBURGH was riding with 7-ft seas and 18-ft swells. The SAGANOSEKI MARU was headed into 10-ft seas and swells.

Late on the 17th (fig. 39), the storm recurved west-

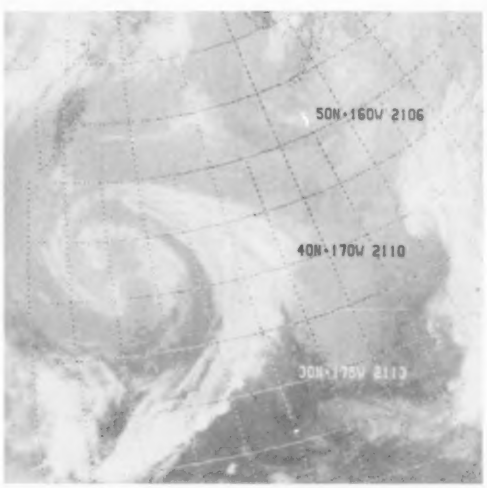


Figure 39.--These two simultaneous satellite strips make an interesting comparison between what is seen by the sensor at two different wavelengths. The left strip is in the visible spectrum and the right is in the infrared spectrum. Note that the tops of many of the low clouds and/or fog are near the water temperature and show only faintly in the infrared range, while the thin-cold high clouds that show only faintly in visible range are very bright on the infrared strip.

ward and on the 18th was moving southward. At 0000, the MAMMOTH FIR, near 46.5°N, 161.5°E, about 180 mi northwest of the center, was hammered by 50-kt winds. On the 19th and 20th, the storm stalled near 40°N, 165°E and weakened rapidly. On the 20th, a new center developed to the south and on the 21st the storm dissipated into the new center.

A fairly large LOW was stalled, near 38°N, 169°E, on the 23d. The front had moved eastward and northward out of the center and a new LOW formed, northeast of the old center, near 49°N, 177°W. Its circulation developed rapidly as it crossed the Aleutian Islands into the Bering Sea. Late on the 24th, it crossed the Alaska Peninsula and Kodiak Island with a central pressure of 992 mb. The ALASKA STANDARD was in Shelikof Strait and was fighting 40-kt winds and heavy rain at 0000 on the 25th.

Twenty five- and 30-kt winds were prevalent throughout the storm's circulation, but the next gale-force winds were not reported until 1200 on the 26th. At that time, the 988-mb LOW was at 52.5°N, 143°W. Ocean Station Vessel "P" and the J.H. TUTTLE near 51°N, 150°W both reported 35-kt gales. The storm turned eastward, on the 27th, from a southeasterly track and began to weaken rapidly. By 0000 on the 28th, it was only a 1009-mb weak area in the pressure gradient, and by 1200 was replaced by a ridge of high pressure.

Monster of the Month--There was no storm this month in either the North Atlantic or North Pacific which was worthy of that name.

Tropical Cyclones, Western Pacific--Dinah was the first tropical cyclone this season to develop west of 140°E. She was detected as a tropical storm on the 8th, about 180 mi east of Samar, in the Philippine Sea. Dinah headed west-northwestward and neared Luzon, on the 9th, as a typhoon. She was already dumping heavy rains throughout the Philippines. She crossed Luzon late on the 9th. In her wake Dinah left 71 persons dead, 14 others missing, and $1 million damage. Most of the destruction came from floods and landslides triggered by the heavy rains.

Weakened by her trek overland Dinah entered the South China Sea as a tropical storm. She headed westward and reorganized. By the 12th (fig. 40), Dinah, once again a typhoon, had turned northwestward. Winds around her center climbed to 75 kt with gusts to 90 kt. After passing east of Hainan the typhoon turned westward and pummelled the Luichow Peninsula on the 13th. After this blow to her circulation Dinah moved across the Gulf of Tonkin as a tropical storm. Later in the day she crossed the coast of North Vietnam.

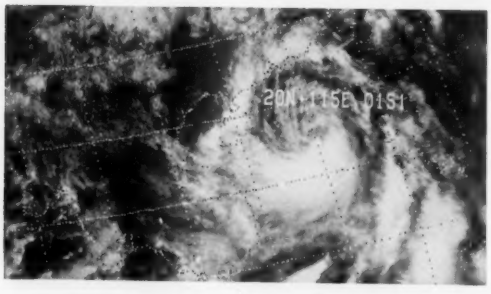


Figure 40.--Dinah is headed for the Luichow Peninsula after devastating Luzon.

Two tropical storms flared up briefly about midway through June. Emma developed off the coast of Luzon, on the 15th, and Freda popped up northwest of Marcus Island on the 21st. Although Emma reached tropical storm intensity in a dangerous area she was already beginning to recurve so Luzon was spared the full brunt of a second storm within a week. Winds near her center reached 60 kt with gusts to 75 kt late on the 15th. She weakened after that as she turned northeastward paralleling the Ryukyu Islands. By the 18th, she dropped to depression strength. Three days later Freda developed into a tropical storm near 25°N; this is fairly far north for tropical development. Winds reached 40 kt near her center for a brief period on the 21st. However, by the following day the eastward-moving storm had weakened to a depression near 25°N, 165°E.

Japan got its first taste of the tropical cyclone season in the beginning of July. Typhoon Gilda roared through the Ryukyus and up the East China Sea. In her wake 136 people were dead or missing.

Gilda was spawned from a northwestward moving tropical depression, on the 1st of July, near 20°N, 134°E. The following day she was a typhoon. Winds of 65 kt blew close to her center. Gales extended out to 150 mi. Gilda continued to grow. Early on the 2d, the NORSE LION was surprised by 45-kt southwesterlies some 200 mi to the northeast of Gilda's core. The SHINKYOKU MARU battled gale force winds in 15-ft seas for most of the 2d; she was 100 to 200 mi away from the center. Some 300 mi away the MATSUMAE MARU ran into 18-ft seas and 35-kt winds. Gilda hit her peak late on the 4th (fig. 41) as she hit the Ryukyus

Figure 41.--Gilda, at 0045 on the 4th, just before reaching her peak strength winds of 95 kt with gusts to 115 kt. Her winds and rain are already beating the Ryukyu Islands.

Figure 42.--These houses were wrecked by a landslide caused by heavy rains with typhoon Gilda on the island of Shodoshima. This slide alone killed 15 people, and 10 were missing. Wide World Photo.

just south of Okinawa. Kume Island reported maximum winds of 101 kt at about 1600 on the 4th. At that time, winds near Gilda's center were estimated at 95 kt with gusts to 115 kt and gales extending out 150 to 200 mi. The real damage was done by torrential rains. Hardest hit was Shodoshima Island, a tourist resort off Kobe. Torrential rains triggered three landslides in a 3-hr period late Saturday night (6th). Seventeen people died and three were missing in these slides. This was the result of about 12 in of rain in less than 24 hr and 2.34 in in one hr. At Ako, Hyogo Prefecture, 11.97 in fell in less than 24 hr.

Gilda was felt most in Shizuoka Prefecture with 44 persons dead or missing and considerable damage. Up to 19 in of rain triggered devastating landslides and floods. Throughout Japan some 560 houses were washed away (fig. 42).

Gilda moved northward through the East China Sea. She began to weaken some as cold air intruded into her circulation. She fell to tropical storm strength as she tried to squeeze through the Korea Strait on the 6th. Once into the Sea of Japan Gilda became extratropical and weakened slowly.

Tropical Cyclones, Eastern Pacific--Northwest winds of 30 kt by the CHIEH HSING 420 mi south-southwest of Manzanillo, Mexico, at 1800 June 4, was the first indication that tropical storm Blanca was forming near 11.5°N, 106°W. Successive satellite pictures showed a westerly movement of 12 to 15 kt with little change in intensity during the first 24 hr. During the following 24 hr, the disturbance slowed to an average of 7.5 kt and increased to tropical storm intensity near 13°N, 113°W at 1800 on the 7th. Winds were estimated at 35 kt.

During this development the AMERICAN RELIANCE, CHIEH HSING, TAIKYU MARU, THEREN, and the WORLD BANNER helped locate the cyclone though all were well away from the center.

A gradual curve northward took the storm to near 14.5°N, 116°W, at 0000 on the 8th, having reached a maximum intensity of 50 kt at 1800 on the 7th (fig. 43).

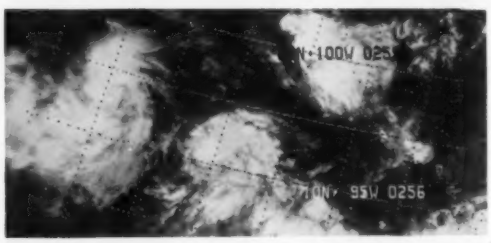


Figure 43.--Tropical storm Blanca is centered, near 14°N, 114°W, in the northern part of the large cloud mass early on the 7th.

As Blanca moved northward over cooler waters decay was rapid. By 1600 on the 8th, winds had decreased to 25 kt near 17°N, 117°W.

The storm travelled in an area of shipping but no winds of gale force (34 kt or higher) were reported.

A low pressure circulation was apparent in satellite pictures beginning June 6, centered about 500 mi south of Zihuantaneo, Mexico. No vessels were in the vicinity until 1800 June 7 when the BARCELONA MARU and the JOHN PENN showed east and west 15-kt winds respectively, each about 100 mi from the center. A northwesterly direction of movement at 5 kt was indicated in successive satellite pictures, on the 7th, but the depression slowed as it intensified to tropical storm Connie, at 0000 June 9, near 12°N, 105°W. A 3- to 4-kt movement continued to near 13.5°N, 109.5°W with wind speeds of 35 to 40 kt.

A more westerly movement began, at 0000 on the 11th, near 13.5°N, 107.5°W and winds increased to hurricane force, at 1800 on the 12th, near 14°N, 110°W. This was the first hurricane spotted by the Geosynchronous Operational Environmental Satellite (GOES) from some 22,000 mi above the equator at 45°W and is shown in figure 44. Further intensification to 110 kt was indicated, at 0000 on the 14th, near 16°N, 113°W. ATS-3 picture (fig. 45) shows Connie at 1741 on the 14th. This picture also shows tropical storm Dolores 200 mi south-southeast of Acapulco.

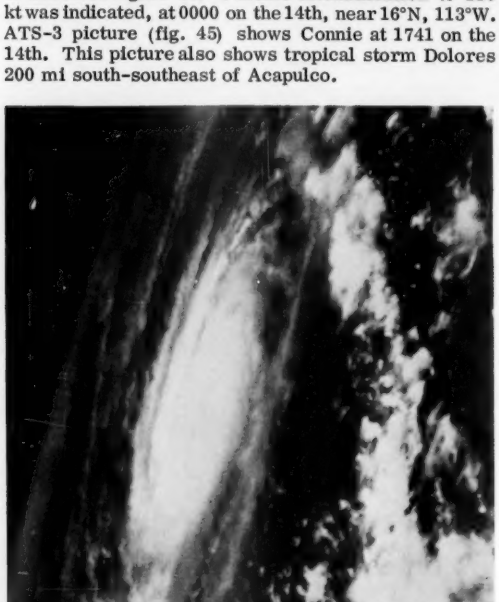


Figure 44.--This is a GOES picture of Hurricane Connie, 420 mi southwest of Mazatlan, at 1828 on June 12. The oblique angle to the satellite distorts the circular cloud pattern but the cirrus cloud outflow and eye are evident.

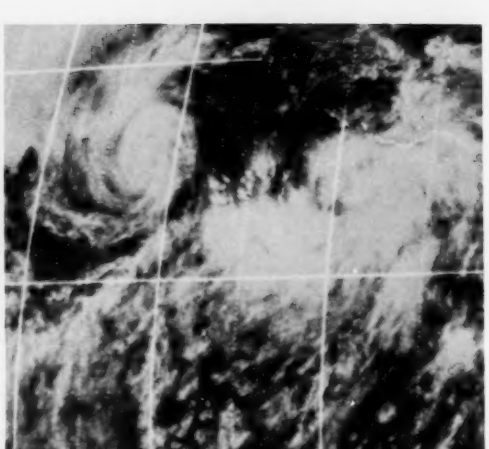


Figure 45. --This ATS-3 photograph shows Connie, near 16°N, 113°W, at 1741 on June 14. Also shown is tropical storm Dolores, 200 mi south-southeast of Acapulco.

Reports from the AMERICAN LEGION and the HOLY about 75 mi north and south of the hurricane, respectively, indicated only 25 kt in their 1800 observations on June 13. This indicated the concentrated circulation that occurs in some of the eastern North Pacific hurricanes. At that time the winds were estimated as 90 kt near the center.

A gradual curve in the hurricane took the center to 16°N, 113°W, at 0000 on the 15th, with the winds weakening to 75 kt and further weakening to a tropical storm at 0000 on the 16th.

As Connie moved over cooler waters she weakened further and curved eastward, forming a loop near 17°N, 112°W, on the 17th and 18th. She became a tropical depression and regenerated to a tropical storm for about 24 hr near 17°N, 107°W, and then curved northwestward again through the 21st. The disturbance dissipated near 21°N, 111°W, at 0000 on the 22d, but a swirl of cloud was still evident in the area through the 23d.

A tropical disturbance began developing on June 13, 300 mi south of Salina Cruz, Mexico, and bulletins on Dolores were issued beginning 0600 June 14. The center of the squally area was near 12°N, 98°W. Early morning satellite pictures showed more definite development, near 13°N, 97°W, at 1200 on the 14th, and a tropical depression bulletin was issued.

ATS-3 pictures showed rapid intensification, during the morning of the 14th, and, by 1800, it was apparent that a hurricane was forming. The TURANDOT, at 14°N, 98.2°W, reported 30-kt winds 150 mi south of the center. Winds near the center were estimated at 50 kt.

Early forecasts moved the storm west-northwestward, but, by 1930 on the 15th, it was apparent that the storm was taking a more northerly track. The

PRESIDENT PIERCE reported an easterly wind of 45 kt at 0000 on the 15th, the first verification that a tropical storm had developed. At 1200, the HU YUNG reported a wind of 5 kt near the center but gave no indication of having passed through heavy weather during the previous 3 to 6 hr. The RIO CALCHAQUI, about 100 mi east of the center, reported south-southeast winds of 45 kt.

At 1800, SHFT reported 40-kt winds, the BRUNSWICK and the PANDO POINT reported 50-kt winds. An 1840 Air Force reconnaissance flight into the storm found maximum winds of 62 kt at about 9,750 ft. The wind speed at about 10,000 ft has been found to be nearly equal to that on the surface. The eye was reported initially at 15.8°N, 98.9°W thus relocating the storm center 80 mi north-northeast of its earlier extrapolated position and changing the direction of movement from northwest to north-northwest. The location was later corrected one degree farther south due to a communication error but an onshore movement was still indicated to near Acapulco within 24 hr. The storm increased to hurricane intensity by 0000 on the 16th.

The hurricane went onshore, about 1300 on the 16th, about 40 mi east-southeast of Acapulco. At 1200 the OCEAN HOPE reported an east wind, 55 kt near 16.3°N, 99°W, or 60 mi southeast of Acapulco, and by 1800 all winds along the coast from 95°W to 105°W were westerly.

Westerly winds of 25 to 35 kt along the coast continued through 0000 June 17 when hurricane advisories on Dolores were discontinued. A strong westerly wind west-southwest of Acapulco, and an unidentified vessel report of westerly 50-kt winds at 15.5°N, 100.3°W suggested that the hurricane had made a loop and moved offshore to about 40 mi south of Acapulco. This belief was held through 1200 on the 17th. A review of time lapse motion pictures for the mornings of June 16 and 17 show that Dolores probably went onshore on the 16th, and that the strong westerlies were from squalls and heavy rains that were reported by vessels during the night of the 16th, and were post hurricane activity.

The heavy rains over Guerrero caused considerable flooding, washed out highways and bridges, and caused mud slides that took nine lives (fig. 46). News reports

Figure 46.--An Acapulco youth looks at the wreckage of a car (to the right and below his right foot) trapped underneath a section of highway that was washed out by hurricane Dolores. The five occupants of the car escaped injury. Wide World Photo.

indicated another 13 to be missing several days after the storm ended.

Casualties--Mexican coastal waters were searched for the 63-ft yacht SHOOTING STAR, after a "Mayday" call on the night of the 15th. Ten persons were aboard. The yacht reported in trouble with 20-kt winds and 15-ft waves in advance of hurricane Connie. A solo transpacific voyager aboard the 6-ton raft INANNA, made of empty oil drums, was rescued, on the 23d, by the Japanese tuna-fishing vessel No. 17 HIYOSHI MARU. The raft had departed Chiba Prefecture, on April 27, and had drifted about 800 mi (1,480 km) to the east.

The Korean fishing boat HAE KUM KANG (726 tons) exploded and sank after a collision with the Japanese fishing boat No. 3 SHINKO MARU (423 tons) in thick fog, on the 29th, about 50 mi east of Cape Nosappu. Three crewmen died and 20 were missing from the Korean boat.

ROUGH LOG, JULY 1974--The number of cyclones were slightly above normal this month. Like the Atlantic, they were generally not very intense. The highest wind reported in any of the extratropical cyclones was 40 kt. There were some fairly significant differences in the primary tracks. The primary track from Japan was more easterly than the climatic northeasterly, until approximately 170°E, when it swung northerly to enter the Bering Sea near the Rat Islands rather than over the Near Islands. The storms that originated in the central Pacific and moved eastward into the Gulf of Alaska were farther south than the climatological track as they approached the West Coast.

The predominant sea-level pressure feature was the Pacific High at 1025 mb. It was located near 35°N, 160°W, 5°S and 10°W of its climatic position. It clearly dominated the eastern ocean. The western part was not as clear-cut with the pressure generally lower than normal with several small pressure centers. A 1011-mb Low was centered off Kamchatka, near 48°N, 168°E, which is indicated as under the influence of the Pacific High in the long-term climatology.

The significant anomalies were negative and they straddled the Pacific High. The weak pressure gradient, the Low off Kamchatka, and the more southerly storm track off Japan are reflected by a minus 6-mb anomaly centered near 40°N, 170°E. The other anomaly was a minus 4-mb center near 45°N, 145°W. This was a reflection of the more southwesterly position of the Pacific High and more southerly tracks of the storms, south of the Gulf of Alaska. The storms had no better luck penetrating the West Coast, though, as the pressure there averaged 2 to 4 mb higher.

The upper-air pattern was more intense than the climatic mean. The High center was about 100 ft greater and located slightly further west, near 33°N, 165°W. The Low was near the pole with a sharper than usual trough extending southward from east of Kamchatka along 165°E. A near normal minor trough was located just off the North American west coast.

There were three tropical cyclones in the eastern North Pacific; hurricanes Francesca and Gretchen, and tropical storm Eileen. In the western North Pacific there were four; typhoon Ivy and tropical storms Harriet, Jean, and Kim.

The first 2 days of the month there were strong winds off the California coast. The Pacific HIGH was pushing against the coastal mountains with a heat LOW inland. At 1200 on the 1st, the EVRR was buffeted by 40-kt winds along 125°W near Eureka. The PITTSBURGH, headed west from San Francisco, had 35-kt gales on her starboard side. At 0000 on the 2d, the STAR ATLANTIC also had 35-kt gales just south of the Golden Gate, and at 1200 the TRANSONTARIO found the same speed further at sea, near 36°N, 125.5°W. On the 3d, the LOW weakened, relaxing the gradient.

Typhoon Gilda entered the Sea of Japan and by 0600 on the 7th was a 992-mb extratropical storm. She was now bringing heavy rain and thunderstorms to northern Japan.

Early on the 9th, the storm passed eastward through the Tsugaru Strait and the TSURUMI MARU, at 39°N, 151°E, was blown by 35-kt gales. At 1200, the CANADA MARU, one degree of longitude east (39°N, 152°E), was headed into 35-kt south-southeasterly gales. The TRANSOCEAN TRANSPORT was about 150 mi east of the center, at 0000 on the 10th, when she was hit by 40-kt gales blowing 15-ft seas, and 15-ft swells. Thousands of homes were flooded (one report indicated 5,152), bridges were washed away, and many landslides resulted from the heavy rains which were continuing. This is a combined total for the tropical and extratropical damage.

The LOW had weakened as it moved over the Sea of Japan and crossed into the open ocean but, late on the 10th and on the 11th (fig. 47), it deepened again. At 1200 on the 11th, it was 978 mb. That day the PITTSBURGH, which had left San Francisco on the 1st, passed about 120 mi south of the center with winds up to 40 kt. The QUEENSWAY BRIDGE was only a few miles to the south and suffered the same fate. The SILVERCOVE was on the north side of the LOW with 35-kt gales. Waves up to 13 ft were being reported on all sides of the storm.

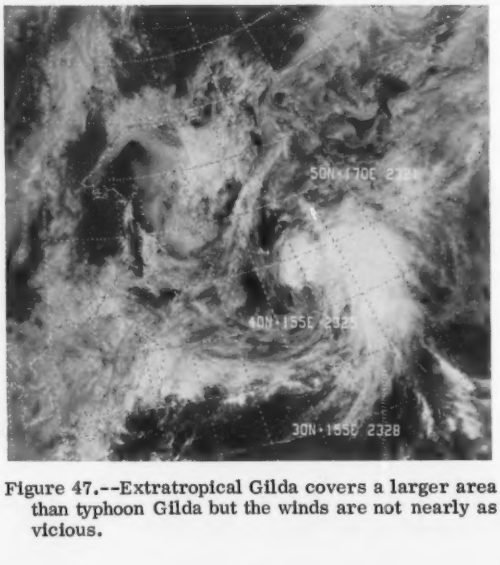


Figure 47.--Extratropical Gilda covers a larger area than typhoon Gilda but the winds are not nearly as vicious.

On the 12th, the EASTERN WORLD was southwest of Attu Island with 40-kt winds and 30-ft seas, and the LOW was moving northward. It continued northward, until 1200 on the 13th, when it abruptly turned eastward for 24 hr. As the LOW slowly filled and moved northeastward through the Bering Sea it brought rain, drizzle, and fog to the area with only light winds. On the 17th, a center could no longer be found.

This LOW formed as a frontal wave, over Shikoku, on the 10th. It moved over the southern coast of Japan behind extratropical Gilda. As it moved over the Kuroshio Current, on the 12th, it intensified to 992 mb. The HAKONE MARU (37°N, 151°E) and the KAKO MARU (38°N, 147°E) were both treated to 40-kt easterly winds with rain. Winds of at least 35 kt were blowing all around the center as the PORTUGAL MARU and JCLK could attest.

The LOW was moving slowly eastward as it passed south of extratropical Gilda early on the 14th. Later in the day it picked up speed and raced across the central ocean at up to 40 kt. During this period the central pressure rose to 1009 mb. As it approached 140°W the speed slackened and the pressure started to fall again. At 1200 on the 16th, there were two 1000-mb centers and the HAWAIIAN CITIZEN received 35-kt gales from the eastern one. Twenty-four hours later the storm self-destructed on the coastal mountains.

This storm started out north of Peking, on the 10th, and moved southward until the 12th. Then, near Shanghai, it headed eastward across the East China Sea. On the 14th, it was over the Sea of Japan. As it moved over the Kuroshio Current it deepened, as had the last storm. At 0000 on the 16th, the ASHBY MARU, near 39°N, 155°E, was about 100 mi east of the 992-mb center with 35-kt winds. By 0000 on the 17th, the 986-mb storm was near 42.5°N, 167°E. Many ships were reporting 25- to 30-kt winds all around its circulation. Southeast of the center the IWAKI MARU, at 39°N, 173°E, found 40-kt gales from the south.

The LOW was now running to the northeast, and, at 0600 on the 18th, crossed the Aleutian Islands near Amchitka Island into the Bering Sea. At 1800 on the 18th, the MAJESTY, near 50.5°N, 172°W, was contending with fog and 40-kt winds. The LOW went ashore, at 1200 on the 19th, and deserted the charts.

Tropical Cyclones, Western Pacific--Tropical storm Harriet was first detected in the Philippine Sea on the 15th. She was already heading northwestward toward Japan. Later in the day Harriet crossed the 20th parallel near 136°E. Maximum sustained winds reached 40 kt near her center the following day; gales extended out about 50 mi. However this was the extent of Harriet's fortunes. After turning northward she weakened rapidly and by the 17th had dropped to depression strength. There was some potential for redevelopment as Harriet moved under an upper-level anticyclone. Cloudiness increased but evidently the system had lost too much of its convection. By the 18th all that was left was a weak depression near 29°N, 136°E.

While Harriet was struggling to survive on the 17th, Ivy and Jean were blossoming on the Philippine Sea. Tropical storm Jean developed near 20°N, about 300 mi east of the Luzon Strait, while Ivy was taking root in a more favorable climate, some 300 mi northwest of Yap Island. Tropical storm Ivy headed west-northwestward while Jean took a northwesterly path. Ivy quickly grew to typhoon strength as she spread toward northern Luzon. By the 19th she was climbing the eastern slopes of the island. Maximum sustained winds were about 100 kt with gusts to near 125 kt. Gales extended out 100 to 150 mi.

Meanwhile Jean was plodding toward Taiwan. Her winds had increased to about 55 kt near the center while gales extended out 50 to 100 mi. Jean brushed northern Taiwan, near Taipei and then clipped mainland China, all on the 19th (fig. 48). She fizzled out the following day east of Shanghai.

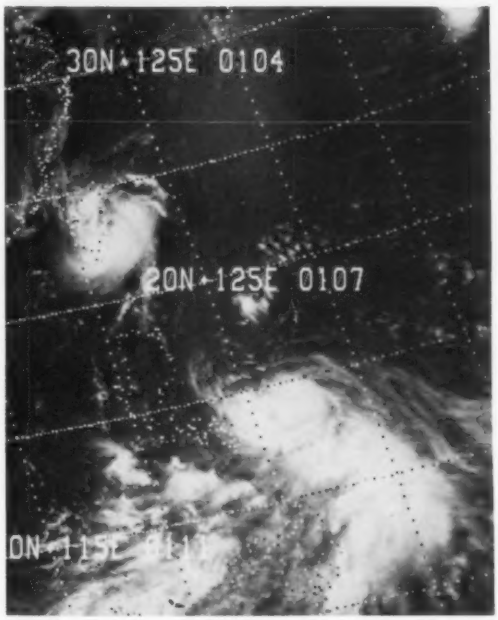


Figure 48.--Typhoon Ivy is approaching Luzon while tropical storm Jean brushes Taiwan early on the 19th.

However Ivy was still spreading. While she made it across the rugged island of Luzon without losing typhoon strength, she was weakened by the trek. Winds near her center fell to 65 kt before she recovered in the friendly waters of the South China Sea. Ivy headed west-northwestward. By the 22d winds had climbed back to 90 kt near her center, with gales extending out to about 150 mi. That day Ivy banged ashore near Tien-pai on mainland China, just 200 mi down the coast from Hong Kong.

Tropical storm Kim flared briefly in the mid-Pacific on the 23d. She was first detected about 250 mi north of Wake Island. She was tropical for just a day. As Kim headed northeastward cold air intruded into the

circulation and she turned extratropical. Winds at the time were about 50 kt near her center (fig. 49).

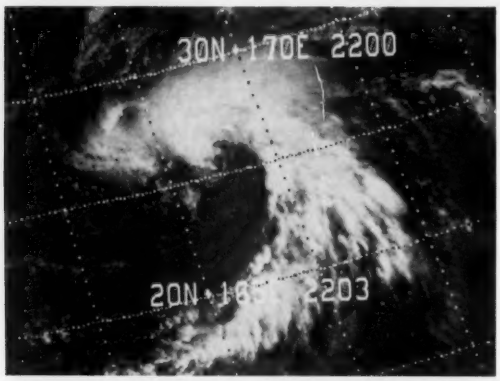


Figure 49.--Tropical storm Kim really never had a chance to develop, forming as far north as she did with no extensive feeder clouds in the southwest quadrant.

Tropical storm Kim was extratropical by 1200 on the 24th. This did not stop the winds from blowing around her wide circulation. At 0000 on the 25th, the 992-mb LOW was at 28°N, 164°E. The ASIA MOMO was about 360 mi to the west, near 29°N, 157°E, with 40-kt gales. The storm had been tracking westward but late on the 25th curved back to a north-northeasterly track. On the 26th, the AMELIA TOPIC encountered 35-kt gales south of the center. On the 27th, the storm was moving northward through the major shipping lanes but no gale-force winds were plotted.

On the 28th, the LOW was again strengthening and had a central pressure of 984 mb by 1200. There were four reports of gale-force winds. They were from the EDELWEISS (16-ft seas and swells), GOLDEN EXPLORER (23-ft swells), TYUMENJNEFT, and the USCGC STATEN ISLAND. About 0600 the storm center had crossed into the Bering Sea. A HIGH was firmly located in the Gulf of Alaska and the highest winds were on the eastern side between these two centers. Two ships and a land station reported 40-kt gales along the Aleutian Islands. On the 29th, the USCGC MIDGETT was bounced by 40-kt winds near Unimak Island. About 1800 that day, the storm passed through the Bering Strait into the Chukchi Sea to disappear.

Tropical Cyclones, Eastern Pacific--Tropical storm Eileen was formed from an area of showers, squalls, and thunderstorms, near 15°N, 110°W, about 500 mi south of the tip of Lower California and began developing on June 28. A gradual intensification took place and the area remained nearly stationary. By July 2, a weak tropical storm had formed, near 16.2°N, 111°W, but no ships were in the vicinity to verify development. Socorro Island, about 200 mi north of the center, reported east winds at 5 kt.

A slow northward movement was indicated with the center of activity moving to near 17.8°N, 111°W by

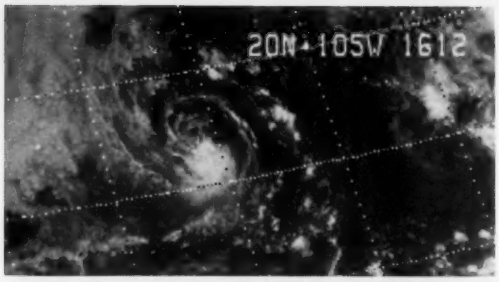


Figure 50.--Eileen is a small storm, at 1613 on the 2d. Although she weakened to a depression on the 3d, her circulation persisted through the 5th.

0000 on July 3 (fig. 50). The storm moved over cooler water and weakened to a tropical depression. The depression continued to weaken. It moved northwestward until 1800 on the 3d, and then westward to near 20°N, 115°W at 1800 on the 4th. The last of the circulation, after the storm dissipated, was still visible in satellite pictures, near 19°N, 114°W, at 2145 on the 5th.

A telltale cluster of clouds in satellite pictures suggested the seventh tropical cyclone (including depressions) in the eastern North Pacific might be forming, near 9°N, 91°W, early on the 12th. The cloud mass which was to be hurricane Francesca was followed westward, on the 12th, with cyclonic circulation beginning about 1800 on the 13th and indicated by the ROSE CITY, IRISH CEDAR, TASMANIC, UYJE, and KFAC, all far enough from the center to experience only light wind and occasional heavy rain.

On the 14th a more northwesterly track began from near 11°N, 99°W to 15°N, 106°W by the afternoon of the 15th. Intensification to a tropical storm occurred early in the night of the 15th, with the storm reaching 50 kt, by 0600 on the 16th, while moving northwestward at 10 kt. This velocity continued (fig. 51) until

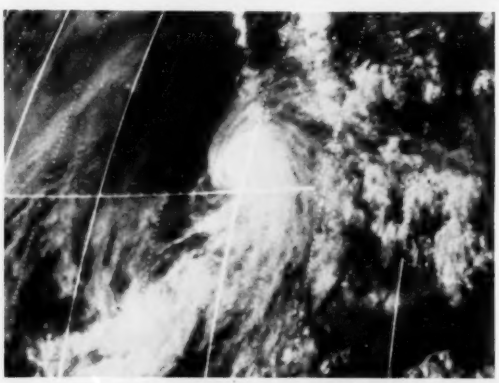


Figure 51.--Late on the 17th, tropical storm Francesca, near 21°N, 110°W, had winds of 60 kt which increased to hurricane strength on the 18th. Gretchen is seen forming to the south.

hurricane intensity was reached, at 1200 on the 18th, near 22.5°N, 112.5°W.

A westward movement and weakening began as Gretchen moved into the area from the southwest and south. Francesca was absorbed by Gretchen near 22.5°N, 119°W, at 1200 on the 19th.

Vessels whose reports helped locate, track and indicate the storm's intensity were the ALEMANNIA, COPAN, HAMBURG EXPRESS, HANYANG, HEMIFUSUS, HOLTAV, LYMAN HALL, NORDSTERN, TIJUCA, WESTER, and the YAMANASHI MARU.

Every few years two tropical cyclones will develop within 600 to 1000 mi of each other and an interesting phenomenon occurs. This was first recognized by Dr. Fujiwhara early in the 1930's. The cyclones tend to rotate around a central point somewhere between the two centers.

Francesca was a developing tropical disturbance near 12°N, 98°W, at 1800 on the 13th, as thunderstorms near 11°N, 114°W began to grow in areal coverage and vertical development. They moved west at 10 kt, then curved to the north and northeast to near 14°N, 116°W, at 0000 on the 17th. Maximum winds were near 30 kt.

As Francesca moved northwestward a band of strong southwest winds moved into the area of the depression, and the warm moist air caused gradual intensification to tropical storm Gretchen, by 1200 on the 18th. Intensification accelerated and successive 30-min satellite pictures indicated hurricane intensity was reached by 1800 on the 18th. From 1800 on the 17th to 1800 on the 18th, the intensifying storm traveled 450 mi. The intensification appeared so rapid that an Air Force reconnaissance aircraft enroute to Francesca was requested also to look over Gretchen. After measuring Francesca the aircraft proceeded to Gretchen at 21.5°N, 111.5°W and measured 85-kt winds 20 mi east of the center at 1946 (fig. 52).

Gretchen curved to the northwest and then westward to 23°N, 119°W, at 0000 on the 20th, and weakened to a tropical storm. It jogged to the north during the night and then westward, dissipating near 25°N, 122°W, at 0000 on the 21st, where the cool water and drier North Pacific air had weakened Francesca earlier.

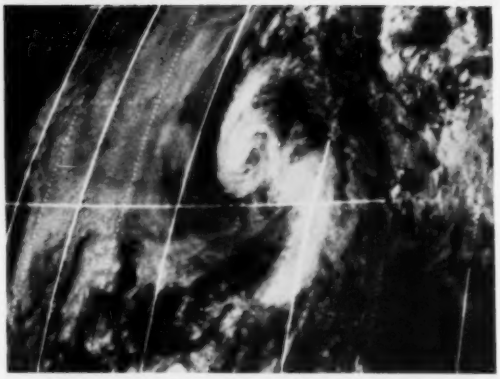


Figure 52.--Gretchen had rapidly intensified to hurricane strength prior to this picture, at 2133 on the 18th.

Although a circulation continued in satellite pictures for several days, surface winds had apparently returned to normal by late on the 20th.

Vessels whose reports were helpful in tracking Gretchen included the CAPISTERUA, CORNELIA MAERSK, HOWELL LYKES, KARUKERA, KAWACHI MARU, KISO MARU, MADAM BUTTERFLY, MARGARET JOHNSON, TAEPING, TOKUSEI MARU, and the WAWAKUSA MARU.

The strongest wind reported by a ship was by the TAEPING, near 19.9°N, 111.5°W, at 1800 on the 18th--55 kt. No reports of damage to vessels have been received.

Casualties--There was heavy fog with visibility down to 300 ft in the Bungo Strait when the 2,999-ton Panamanian WESTERN STAR and the 12,292-ton KIKKO MARU collided, at 5:30 a.m. on the 28th. The WESTERN STAR sank almost instantly and 24 crewmen were missing, 2 were rescued. Patrol boats, an airplane, and a helicopter searched for survivors.

Marine Weather Diary

NORTH ATLANTIC, OCTOBER

WEATHER. Storms in the middle and higher latitudes increase in frequency and energy during October. The westerlies have pushed southward, and the 1002-mb Icelandic Low, centered about midway between Iceland and southern Greenland, is stronger than it was in September. The Azores High, centered near 34°N, 35°W, is only slightly weaker (at 1020 mb) than in the preceding month, but it has diminished in size.

WINDS. North of 40°N, prevailing winds are westerly (generally of force 4 to 6 north of 50° N and 3 to 5 between 40° and 50° N), except over the Norwegian Sea where southerlies dominate; the North Sea, Baltic Sea, and some other eastern waters which host southwesterlies; the area near the Icelandic Low where winds are variable; and an area southeast of the Davis Strait which has a preponderance of light (force 2) northerlies and southeasterlies. South of the 40° line, northeasterly winds are prevalent (about force 3). Southeasterly force 3 winds blow near the Equator between South America and Africa. Northwesterly winds, force 2 to 3, generally prevail over the Mediterranean Sea.

GALES. Both the frequency of and the area subject to gales increase markedly over the previous few months. Winds of force 8 or more can be expected oceanwide north of about 40°N, with a frequency from 5 to over 20 percent. The highest frequencies occur over a small area south of Greenland's southern tip, the Greenland Sea, and the northern portion of the Norwegian Sea. An analysis of eight Ocean Station Vessels north of 40° N indicates that gales generally last less than 1 day over these waters.

EXTRATROPICAL CYCLONES. The temperature contrast off the Atlantic coast, from Labrador through the Carolinas, is conducive to cyclogenesis. Other principal areas of cyclogenesis lie over midocean within an egg-shaped area oriented in a northeast-southwest fashion and comprising a 250- to 300-mi-wide area between 56°N, 23°W and 48°N, 37°W; over the Bay of Biscay; within the coastal area from Marseille east-southeastward to Naples; over all but the extreme southern part of the Adriatic Sea; over the Skagerrak, the Kattegat, and the Baltic Sea to about 61° N; off the northern Norwegian coast; east of Iceland; and off the Denmark Strait coast of Greenland. There are more extratropical cyclones than in September, but primary storm tracks are similar, although most are displaced a little farther south. The secondary cyclone track over the northwestern Mediterranean area has lengthened and become of primary importance. Primary tracks are also found over North America from Kansas across the Great Lakes to James Bay and from James Bay to the Labrador coast. Portions of the Scandinavian track and the midocean track toward southern Iceland have less cyclone activity than in September. Occasionally North Atlantic extratropical storms, being of considerable intensity, generate hurricane or near-hurricane-force winds.

TROPICAL CYCLONES. The hurricane season continues into October, but after the middle of the month, the probability of a tropical storm occurrence diminishes rapidly. Since 1931, 79 tropical storms have popped up over the North Atlantic, and 53 percent of these have become hurricanes--a smaller percentage than in August or September. The great majority of the 77 storms developed before the 21st of the month. Most October storms form over the western Caribbean, but some are spawned near the Lesser Antilles. Recurvature usually takes place farther south and east than in September.

SEA HEIGHTS. During October, sea heights of 12 ft or more are usually encountered 10 percent or more of the time over the open ocean north of about 40°N (excluding most of the Norwegian Sea), over the Gulf of Lions, and over central Hudson Bay. An area of 20-percent frequency extends southward from the Denmark Strait to between 55° and 62°N, then east and west over the waters south of Iceland and Greenland. A second, much smaller area is centered near 50°N, 40°W.

VISIBILITY continues to improve during October compared with the previous month. Frequencies of 10 percent or more of visibility less than 2 mi are now found in only three scattered areas--the southern Davis Strait and northern Labrador Sea, over waters due east of Newfoundland, and from the southern reaches of the Denmark Strait southeastward to the Faeroe Islands and then north-northeastward to the Greenland Sea. As in September, the cold waters north of Iceland entertain an area of 20- to 30-percent frequency of visibility less than 2 mi and a small area (within this larger area and centered near 68°N, 18°W) where visibility less than 2 mi exceeds 30 percent of all observations.

NORTH PACIFIC, OCTOBER

WEATHER. October marks the transition to winter conditions over the northern latitudes of the North Pacific. The Aleutian Low lying off Cape Newenham, Alaska, has deepened 4.5 mb (as compared to September) to 1002.5 mb, while the subtropical High has become a flat east-west ridge, centered roughly along the 33d parallel, containing a maximum pressure of about 1020 mb.

WINDS. Between 40° and 60°N, westerly winds predominate with forces 4 to 6 most frequent. However, northwesterlies and northerlies prevail over the eastern Bering Sea, easterlies dominate the Gulf of Alaska, and winds off the coast of British Columbia normally blow from the southwesterly quarter. North of 60°N, conditions are relatively unchanged compared with those of the preceding month. From 30° to 40°N, directions are more variable with northeasterly and northerly winds prevalent east of Honshu and northwesterlies common east of the dateline, shifting to northerly near the California coast. Force 4 winds constitute the largest percentage frequency within the above latitudinal belt. The "northeast trades" (averaging slightly less than force 4) prevail between the Equator and 30° N. Northerly force 3 winds are the general rule out from the Gulf of Tehuantepec. The winter monsoon is now well established over Asiatic waters, penetrating as far south as Indochina.

GALES. The chances of encountering winds of force 8 or higher increase appreciably in October, particularly in the middle and higher latitudes. The highest incidence of gales occurs between 48° and 56°N, from Kamchatka eastward to about 140°W, with 10 to 20 percent of the wind observations over most of these waters revealing gales. Ships plying the central Bering Sea as far north as the 63d parallel are also laced by gale-force winds more than 10 percent of the time. There is a gradual decrease in frequency southward--gales are infrequent south of 30° N over the central ocean, 35° N over the western ocean, and about 44° N above eastern waters. Nevertheless, gales are observed between 5 and 10 percent of the time over the typhoon-troubled waters near Taiwan and those southwest of Japan.

EXTRATROPICAL CYCLONES. The frequency and intensity of extratropical cyclones increase in October. A principal area of cyclogenesis lies within a large region surrounding the Liaotung Peninsula (mainland China), Korea, the northern Ryukyus, all of Japan (including the Sea of Japan), and most of Sakhalin. In some places north of 40°N, this area extends as far east as 160° E. Other major regions of cyclogenesis are situated over the Gulf of Alaska, off the coast of British Columbia and the U.S. Pacific Northwest, and over a fairly large eastern ocean area centered about midway between the Alaska Peninsula and the Hawaiian Islands. Primary storm tracks over central and eastern waters now extend along the Aleutian chain to the Gulf of Alaska or arrive in the Gulf after following a more northeasterly path. Over western waters, storms reach the western Aleutians either by passing over Sakhalin and lower Kamchatka or by developing strength east of Japan.

TROPICAL CYCLONES. Three or four tropical storms can be expected to develop over the tropical waters of the Far East. On the average, two or three reach typhoon intensity. Most of these tropical cyclones

form at low latitudes in an area extending from the Philippine Islands to about 155°E. Their early movement is generally west-northwestward, and most recurve east of the Philippines or Taiwan and sweep up along the east coast of Japan. A smaller number move across the Philippines into the South China Sea; a still smaller number reach the Asiatic mainland.

In the tropical waters of the eastern North Pacific, tropical cyclones are less frequent than in September, averaging about two per year. Roughly half of these storms reach hurricane intensity at some time in their lives. October tropical cyclones follow less regular tracks than those of September. After developing off the coast of southern Mexico-Guatemala or near the Revillagigedo Islands, a large percentage of these storms will move inland over Mexico south of about 30°N.

SEA HEIGHTS of 12 ft or more affect the same general areas as in September, but frequencies greater than 10 percent are much more common over the northern shipping lanes, covering an area extending from about 140° W to 160° E and from the Aleutians southward to about 45° N. The area over the lower Gulf of California with frequencies of 2 to 10 percent is no longer present, but a new quite small area appears near 13° N, 145°W.

VISIBILITY. Percentage frequencies of low visibility decrease in October. Visibility less than 2 mi occurs 10 percent or more of the time north of a line drawn from Ostrov Karaginski eastward to a point northeast of the Pribilofs and then southwestward across the Fox Islands to a point near 42°N, 175°W. From there, the line extends eastward across the 155th meridian and then northward to Kodiak Island.

NORTH ATLANTIC, NOVEMBER

WEATHER. While normally November is considered a transitional period between fall and winter weather over northern waters, this month develops occasionally into the severest of the winter season. Most rough weather is confined to north of 45°N except along the coast of the United States where there is an increase in winter-type LOWS. Over the Great Lakes Region, two primary storm tracks--of Alberta and Colorado LOWS--converge into an area of maximum cyclone frequency, contributing in a large measure to rough weather toward the close of the Lake's navigation season. The Icelandic Low (1002 mb) is still centered between Iceland and southern Greenland. The Azores High has shifted eastward and is centered near 33°N, 29°W; its central pressure has risen slightly to about 1021 mb.

WINDS north of 60°N are quite variable at about force 3 to 4, although these winds tend to come from the northerly quarter west of Iceland and from the southerly quarter east of that island nation. Westerly winds, force 4 to 6, prevail over most of the ocean between 40° and 60°N. Between the latitudes of 30° and 40°N, force 3 to 4 winds are of variable direction except east of the Azores where a noticeable northerly component prevails. The "northeast trades," averaging force 3 to 4, extend from 30°N southward to 10° N. Between 10° N and the Equator, southeasterlies (force 3) are predominant.

GALES. The frequency of gales over northern and middle latitudes increases substantially in November. Winds of force 8 or higher occur 10 percent or more of the time over most areas north of about 35°N over western waters; north of about 40°N over the central ocean; and north of about 44°N over eastern waters, including the southern half of the North Sea. A 10-percent frequency of gales is encountered on the Mediterranean only over the Gulf of Lions. Frequencies are generally less than 10 percent, however, over the waters between Iceland and southern Greenland (near the center of the Icelandic Low) and over a relatively small area about 200 mi northwest of the western Irish coast. Frequencies of 20 percent or more occur in the Davis Strait north of 63°N, south of Greenland in the vicinity of 55°N, 45°W, and over most of the Norwegian Sea.

EXTRATROPICAL CYCLONES. The principal track of extratropical LOWS is northeastward from the waters off Cape Cod, across Newfoundland to Iceland, and then through the Norwegian Sea. Sometimes these cyclones will approach Iceland from the central part of the North Atlantic Ocean. Other major tracks lead from Hudson Bay to the Davis Strait and from the Gulf of Lions to Italy.

TROPICAL CYCLONES are infrequent in November. Usually one storm in 3 yr may be expected. In the 43-yr period, 1931-73, 16 tropical storms occurred and 7 reached hurricane strength. Most of these storms develop over the Caribbean Sea or eastern Gulf of Mexico, and are soon following a northeasterly path out over the main body of the North Atlantic.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time on most of the ocean north of about 40° N and south of the Davis Strait and the Norwegian Sea, and on the Mediterranean Sea in the Gulf of Lions and the northern Aegean Sea. The frequency increases to 20 percent or more over most of the waters between 47° and 60°N and over the Denmark Strait.

VISIBILITY less than 2 mi reaches a frequency of 10 percent north of a line drawn from the waters around Kap Farvel west-northwestward to Saglek, Labrador (55 mi northwest of Cod Island), and north of another line extending from Angmagssalik, Greenland, to northwestern Iceland, then across land to the Vesturhorn (eastern Iceland), then eastward to 64°N, 7°W; it then stretches north-northeastward across the Norwegian Sea to the waters north of Norway. An area of frequencies exceeding 20 percent or more lies north of Iceland between 67° and 72°N, eastward to about 5°W.

NORTH PACIFIC, NOVEMBER

WEATHER. November is often a stormy month north of 35°N over western waters and about 40°N over the eastern ocean. There have been years when November was the stormiest month of the winter season, but generally the weather is not too severe and there may be quiet periods lasting several days. South of 40°N, the probability of severe extratropical storms diminishes rapidly with latitude. During November, the Aleutian Low near 55°N, 176°W is well estab-

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lished over northern latitudes with a central pressure of 1000 mb. The Pacific Subtropical High, at 1021 mb, is slightly stronger than in October and is centered near 31°N, 145°W. Off the Chinese coast, pressures are higher than during October because of the buildup of the cold Asiatic High.

WINDS. Over the ocean north of 55°N, northerly winds (force 4 to 6) prevail, except over the eastern Bering Sea where winds are variable and the Gulf of Alaska where easterlies and northeasterlies are most common. With the exception of the area east of 140° W where southerly and westerly winds are prevalent, westerly winds (force 4 to 6) predominate between 55° and 35°N. Variable winds near force 4 are most frequent between 35° and 25°N, except over the Yellow Sea and waters off Japan where northerlies predominate. The northeast monsoon, affecting areas west of 140°E, and the "northeast trades" blow steadily at about force 4 south of 25°N. Lighter force 2 to 3 winds are the rule over the southern limits of the South China Sea, east of the Gulf of Siam. Northerly winds blow steadily out from the Gulf of Tehuantepec, off Mexico's south coast. They reach gale force between 5 and 10 percent of the time just west of the gulf.

GALES occur 5 percent or more of the time north of about 35° N. An area of 5- to 10-percent frequency is also found over the northern reaches of the South China Sea, including the Formosa Strait and the Luzon Strait, and west of the Gulf of Tehuantepec, as mentioned above. Actually, a frequency of 10 percent or more is found over most of the waters north of 35°N with the exception of the eastern Pacific east of 154°W (south of 50°N) and the waters east of the Kamchatka Peninsula. A small area of maximum frequency, where gales occur 20 percent or more of the time, is centered about 225 mi southeast of the southern tip of Kamchatka.

EXTRATROPICAL CYCLONES. The main storm tracks extend northeastward from the Japanese Islands to the western Aleutians and then east-northeastward to the Gulf of Alaska. Another primary cyclone track enters the gulf from an area in the central ocean near 47°N, 169°W. In November, there are more LOWS passing over the Gulf of Alaska than any other part of the Northern Hemisphere; this is also true of 5 of the following 6 months.

TROPICAL CYCLONES. On the average, two or three tropical storms develop over the western North Pacific in November. Two of these usually reach typhoon intensity. The region of most frequent formation is in the vicinity of the central and western Caroline Islands; the tropical cyclones either travel westnorthwestward over the Philippines and the South China Sea or they recurve near 15°N, 132°E, to pass east of the Japanese Islands.

Tropical storm frequency over the eastern North Pacific drops rapidly for November, averaging about one every 2 yr. None have developed to hurricane intensity. During the 1956-73 period, one tropical cyclone occurred in the central North Pacific. When these late-season storms do develop in the eastern ocean, their direction of movement is usually more northerly than westerly.

SEA HEIGHTS of 12 ft or more are generally encountered 10 percent or more of the time within an area extending south-southeastward from Hokkaido to about 35°N and then eastward to 160°W. From there the line bounding the area travels north-northeastward to a point near 53°N, 142°W, and then westward across the Fox Islands and the Rat Islands to east-central Kamchatka. The Sea of Okhotsk is not included within this very large area of frequencies greater than 10 percent. A small area of frequencies exceeding 10 percent is found over the waters surrounding Taiwan. A maximum frequency of 20 percent extends southeastward from the southeast coast of Kamchatka to about 44°N, 170°E.

VISIBILITY. Frequencies of low visibility (less than 2 mi) greater than 10 percent lie north of a line drawn from Mys Terpeniya, Sakhalin, eastward across the central Kurils and then north-northeastward to the waters east of the Komandorskiye Islands. From there the line stretches northeastward to St. Lawrence Island and the Seward Peninsula. Two smaller regions of 10 percent or greater frequency are centered over the Bering Sea near 54°N, 173°W, and over the midlatitudes of the eastern North Pacific near 46°N, 146°W.

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